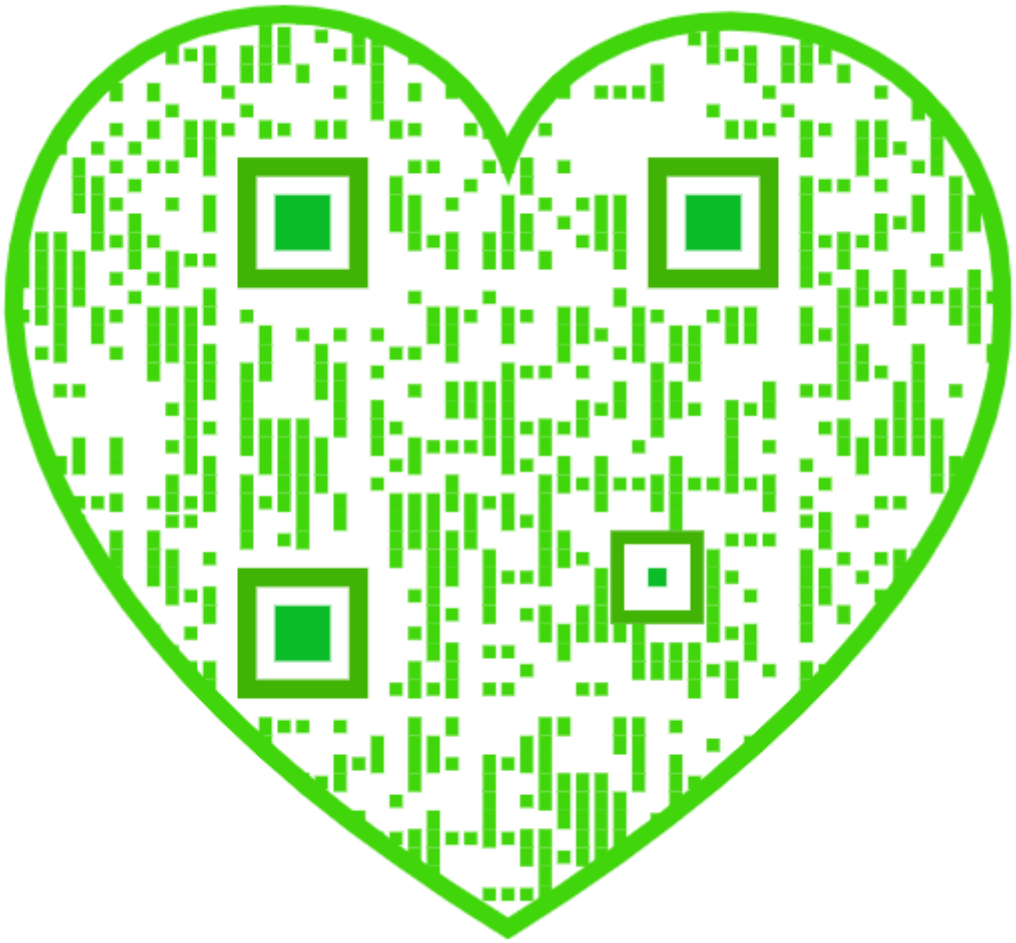

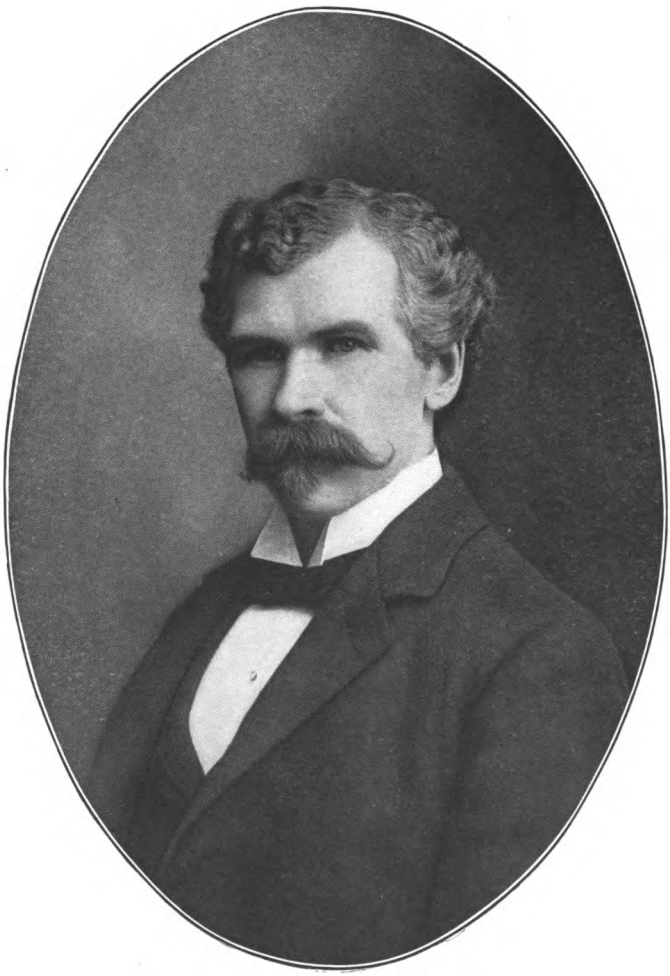

Fraternally Yours

A. M. Martin

A

NEW TREATISE

ON

THE MODERN METHODS OF CARBON PRINTING

(SECOND EDITION)

BY A. M. MARTON

AUTHOR OF

THE PHOTO-OLEOGRAPH PROCESS; THE ART OF PAINTING PHOTO-OLEOGRAPHS IN OIL OR WATER COLORS, AND THE ART AND PROCESSES OF CERAMIC PHOTOGRAPHY.

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PREFACE.

EVERY progressive and up-to-date photographer who desires to select the best and most capable printing process for his work, will naturally weigh and compare the simplicity and facility of the operations involved in the various printing processes, and the stability and intrinsic value of the final results, before he will choose or settle down to any one method.

As a rule, the professional takes up photography for its results, and is not imbued with much ardor to enter upon a course of laboratory experiments, but wishes to accomplish his aim by the quickest and most practical methods available.

The Carbon Process of today is simplicity itself, a fact that ought to be known by every photographer, to whom the virtues and simplicity of this beautiful process must appeal.

It is a sad fact, but an undeniable truth, that to be confronted with a faded and yellow photograph, (which is getting to be a matter of frequent occurrence,) is a source of great mortification to the photographer whose name is associated with or appears on the mount of such a picture.

If we look at the work of the leading professionals of today, we find that the pictures they stake their reputation on, are printed in carbon. It is also a notable fact that the work intended for all permanent exhibits, salons, art galleries, etc., or pictures for historical purposes, will not be accepted unless they are printed in carbon.

It is the indisputable permanency of carbon pictures, that appeals with irresistible force to every professional or amateur photographer who has the good and reputation of the profession at heart.

The improved papers and materials now so readily obtainable, eliminate the greater part of the difficulties encountered by the carbon printers of former years. The improvements in materials are most noticeable in the delicacy and richness of tone and the artistic beauty imparted to the pictures by the various surface textures of the supports now in use.

The great advantages and supremacy of the modern carbon process in its present state of perfection, is now universally recognized by the profession, the world over.

In the following pages, I will try and give the result of many years of practical experience; and that of other workers whom I have come in contact with during my long career as a professional carbon printer. I will give all there is to be known about the process, and will endeavor to make this the best and most practical treatise of the kind, ever published.

Fraternally,

A. M. MARTON.

TABLE OF CONTENTS.

PART I.

CHAPTER I. Page

The Introduction 9

CHAPTER II.

A Brief Recapitulation of the Entire Carbon Process 12

CHAPTER III.

Words and Terms used in the Carbon Process 14

CHAPTER IV.

The Work Rooms, Arrangement of Light, etc 20

CHAPTER V.

The Carbon or Pigment Tissue.—Its Condition and Appearance—Its Printing Qualities 23

CHAPTER VI.

Bichromate of Potash.—Bichromate of Ammonia.—Bichromate of Sodium.—Bichromate Poisoning 26

CHAPTER VII.

The Bichromate Bath.— Formulae for Special Purposes.—Bath for Carbon Vignette 28

CHAPTER VIII.

Practical Notes on the Various Chemical Constituents of the Bichromate Bath 36

CHAPTER IX.

The Squeegee, its Construction and Use.—Rubber Cloth and Thin Transparent Celluloid 39

CHAPTER X.

Sensitizing the Tissue.—The Varous Methods in Use 41

CHAPTER XI.

Drying the Sensitive Carbon or Figment Tissue.—The Various Devices and Methods.— Apparatus for Rapidly Drying Carbon Tissue.—Tissue for immediate use.—Marton's New Rapid Method. 48

CHAPTER XII.

Care of the Sensitive Tissue.—Remarks 56

PART II.

CHAPTER I.

The Negative.—Quality and Style.—Prisms and Reversing Mirrors.. 61

CHAPTER II. Page

Stripping and Reversing Negatives made on Ordinary Dry Plates.—Reversing and Transferring the Image to another Plate by Contact..... 66

CHAPTER III.

The Make-ready or Preparing the Negative for Printing.—The Safe Edge.. 74

CHAPTER IV.

The Photometer.—Marton's Photometer 78

CHAPTER V.

Printing Operations.—Finding the Speed of a Negative..... 82

CHAPTER VI.

The Continuing Action of Light.—Theory of the Latent Image and its Development 87

PART III.

CHAPTER I.

The Single Transfer Process.—Preliminary Remarks.—Single Transfer Supports.—Systematic arrangement of Trays, Tanks and Developing Apparatus 91

CHAPTER II.

The Transfer, or Mounting the Exposed Tissue upon Supports for Development.—The Transferring Machine.—Temperature and Climatic Conditions..... 97

CHAPTER III.

The Hot Water Supply 106

CHAPTER IV.

Development.—Preliminary Remarks.—The Development.—The Reduction of Over-printed Carbon Pictures.—Carbon Printing in Hot Weather 108

CHAPTER V.

Marton's Perfection Developing Tray.—The Vertical Developing Tank and its Advantages and use for the Development of Carbon Pictures.. 117

CHAPTER VI.

The Development of Carbon or Pigment Pictures upon Heavy Celluloid, Porcelain or Opal Glass 126

CHAPTER VII.

Carbon Printing in Hot Weather.. 129

CHAPTER VIII.

The use of Acids and Alkalies in Development.—General Remarks. 132

CHAPTER IX. Page

The Reduction of Carbon Pictures.—The Alum Bath.—Cleaning Solutions.—Finishing 138

CHAPTER X.

The Double Transfer Process.—Waxing Solutions..... 143

CHAPTER XI.

Opal and Ground Glass Temporary Supports 147

CHAPTER XII.

Double Transfer Pictures From Polished Glass for Pictures with a Brilliant Surface 150

CHAPTER XIII.

Transfer to Dry Collodion Plates, for Pictures with a High Gloss ... 154

CHAPTER XIV.

The Wet Process.—With Collodion Film.—Mounting the Exposed Tissue for Development 157

CHAPTER XV.

The Final Transfer From a Flexible Support.—The Final Supports.. 161

CHAPTER XVI.

Final Transfer from Glass or Opal Plates 166

CHAPTER XVII.

Mounting and Finishing.—The Card Mounts.—Spotting and Coloring. — Enameling Carbon Prints. — Imitation of Burnt-in Enamels..... 170

CHAPTER XVIII.

Carbon Pictures Upon Ivory, and Imitation Opal Supports.—Carbon Pictures Without Transfer.—Pigment Pictures upon Canvas as a basis for Painting in Oil Colors. 175

PART IV.

CHAPTER I.

Carbon Positives on Glass.—Preliminary Remarks 181

CHAPTER II.

The Preparation of Glass Plates for Window Transparencies.—Lantern Slides and Negatives 183

CHAPTER III.

Window Transparencies in Monochome and Colors by Superposition of various Pigment films 186

CHAPTER IV.

The Lantern Slide. 190

CHAPTER V.

Toning and Intensifying Carbon Pictures and Transparencies.—Local Toning.. 194

CHAPTER VI. Page

The Reproduction of Negatives from Carbon Positive Transparencies 198

CHAPTER VII.

Carbon Enlargements by Artificial Light and the Solar Camera.—The Negative.—The Enlarging Lantern.—The Solar Camera....202

CHAPTER VIII.

Failures.—Their Cause and Remedy—Conditions of Permanency...206

PART V.

The Appendix.

CHAPTER I.

Carbon Tissue.—The Requirements for its Manufacture in the Studio.... 214

CHAPTER II.

The Choice of Pigments or Coloring Matter.—Description of Pigments..... 217

CHAPTER III.

The Manufacture of Carbon Tissue in the Studio..... .. 222

CHAPTER IV.

The Gelatine Compound.—Mixing the Pigments or Coloring Matter.—Black Transparency Tissue.—Graphite Tissue.—Tissue for Transparencies and Lantern Slides.—White Tissue.—Polychrome Tissue 225

CHAPTER VI.

Preparing the Pigment Compounds..... 234

CHAPTER VII.

Coating the Paper With the Pigmented Jelly.—The Coating Machine—Daylight Tissue 236

CHAPTER VIII.

A Brief History of the Carbon Process.. 242

CHAPTER IX.

Patent Specification of Swan's Carbon Process, etc 245

CHAPTER X.

Improvements of Swan, Johnson, Sawyer and Lambert 257

Part I.

CHAPTER I.

THE INTRODUCTION.

TO the discoverer of the use of carbon as a coloring matter, whoever he may have been, the world owes a debt of gratitude; for the history of all past ages, from the remotest periods of antiquity up to the present day, has been written in this imperishable substance.

The characters of the ancient documents, so highly treasured for their great antiquity; many of them dating back to the early dawn of history, forty or fifty centuries ago, were written in carbon, and some of them are almost as readily deciphered today, as they were at the time of their writing.

The Chinese claim to have a written history of their people and empire, bordering back onto the dim, gray ages of pre-historic man, which, of course, was written in Chinese ink, a substance composed of the purest carbon obtainable. The above facts ought to be a sufficient recommendation for the employment of carbon as a coloring matter in photography.

From the earliest days of the process, up to the present time, it has been the desire of many eminent amateur and professional photographers, to invent a process that would produce photographic impressions that would be imperishable and absolutely proof against the ravages of time.

In the modern carbon or pigment process, this has been accomplished beyond all expectation; and in many respects, the results aimed at by the early workers in this field of photography, have been greatly surpassed.

Prompted by a desire to discover a process that would yield really permanent results, the Duke of Luynes, France, in 1858, offered a reward of 2,000 francs for the invention of a photographic process, by which could be produced, photographs that would be as permanent and imperishable as printer's ink. This stimulated the experimental work in carbon printing, and resulted in many valuable discoveries and improvements of the process in the following years. Long since then, the carbon process has advanced from the experimental stage to a state of perfection and practicability that brings it to the foremost rank of all photographic printing processes, and is now universally recognized as the leading process and used as a standard of comparison whenever reference is made to artistic qualities or undaunted permanence.

The name "carbon" has been erroneously applied to all pictures made by this process. "Pigment process" is probably the most proper application for the reason that a greater per cent of the pictures are now made in various pigments, instead of carbon or lampblack. The purest carbon obtainable as a coloring matter is lampblack or india ink. This was at first employed exclusively in the manufacture of carbon tissue, and for that reason this process of printing was called the "Carbon Process." While carbon is the most important and reliable coloring matter available for this purpose, any suitable pigment or coloring matter such as Venetian red, Van Dyke brown, Sepia, etc., may be used, hence the more modern name, "Pigment Process."

The photographic image composing the carbon picture is

without a doubt absolutely permanent, as far as the coloring matter is concerned, which then places the perishability of carbon pictures entirely upon the stability of the support. Of these, there are now such a variety, that there need be no difficulty in selecting one that will be equal in stability to the pigment used.

CHAPTER II.

A BRIEF RECAPITULATION OF THE CARBON PROCESS.

TO convey a general idea of the work or methods employed in the production of carbon pictures, without studying the process at length, I will give a brief recapitulation of the manipulations and working details involved in carrying out the process.

A compound of gelatine and sugar is charged with a coloring matter, such as lampblack, india ink, or any other suitable pigment, and is spread in a uniform coating over a smooth sheet of paper. When dry, the pigment paper or Carbon Tissue, as it is usually called, is immersed for a given length of time in a solution of bichromate of potash, which renders it sensitive to light and capable of receiving an imprint from a negative. As soon as the tissue is dry it is ready to be printed upon, in the same manner as on printing out paper with the exception that we cannot observe the progress of printing by inspection. The light passing through the negative has a hardening effect on the bichromated gelatine, and leaves no visible imprint upon the film, by which to judge the exposure, and consequently it must be gauged or measured by the aid of an actinometer, or exposuremeter.

There are two different methods of making carbon pictures,—the single and double transfer methods; the former is by far the easier and most simple process, but unless the negatives have been corrected, the image will be reversed. This reversal formerly proved to be a great detriment to the process, and caused it to be looked upon as an inferior method.

But with the improvements in making reversed negatives, which are now in common use among carbon printers, this process is almost universally employed for pictures with a matt surface, for which it is especially well adapted.

The process of development in brief, consists in immersing the tissue in cold water until it begins to flatten out, when it is immediately brought in contact with some sort of a support, such as paper, celluloid, or opal glass, and squeezed into intimate contact therewith.

After it has been allowed to rest for a short time under slight pressure, the support and adhering tissue are immersed in warm water, which in a few moments dissolves the gelatine, and allows the paper to be stripped from the tissue, leaving the pigmented film firmly adhering to the new support.

The surface of the tissue proper is now exposed to the action of the warm water, which immediately dissolves and washes away the soluble or unaffected parts of the gelatine film, not acted upon by light, and thus causes the latent image to gradually appear from beneath the mass of pigmented gelatine.

The Double Transfer Process involves one more operation which is strictly necessary to produce correct or non-reversed pictures; such as landscapes, buildings, interiors, etc., from ordinary or non-reversed negatives.

The developing manipulations proper are practically the same as for single transfer. The only difference is that the tissue bearing the latent image is first transferred to a temporary or intermediate support, such as opal glass, zinc, plain glass, or a heavy flexible paper. From these it is transferred to the final support, which again reverses the image and brings it into its correct position; this involves the manipulations from which the process takes its name—double transfer.

CHAPTER III.

WORDS AND TERMS USED IN CARBON PRINTING—MATERIAL AND REQUISITES USED IN THE PROCESS.

Carbon.—The carbon used in this process is the black coloring matter employed in the manufacture of tissue; which is lampblack or pure carbon.

Carbon Tissue.—A paper coated with a compound made up of gelatine, sugar and lampblack.

Pigment Tissue.—A paper coated with a pigmented gelatine compound.

Transparency Tissue.—A paper coated with a gelatine compound having an excess of finely divided coloring matter, such as filtered india ink.

Sensitizing Bath.—A solution of bichromate of potash or ammonia, used to make the tissue sensitive to light.

Exciting or Sensitizing Carbon Tissue.—Immersing carbon paper into a solution of bichromate of potash or ammonia.

Actinometer.—A small instrument used for measuring the time of exposure, or registering the action of light upon sensitive carbon tissue when exposed under a negative.

Safe Edge.—Usually a mask made of an opaque paper, of some non-actinic color, such as red, yellow or green; with an opening of the size and shape of the picture desired.

Pressure Frame.—A printing frame of any description used for printing carbon pictures.

Continuous Action of Light.—A peculiar property of bichromated gelatine, is the continuous action or insolubili-

zation that goes on after the sensitive film has been exposed to light under a negative. This hardening action goes on in the dark after the tissue has been removed from the negative, and is greatly stimulated by heat and moisture.

Single Transfer Process.—A method of developing carbon pictures, necessitating but one transfer.

Double Transfer Process.—A process of developing pictures upon a temporary or intermediate support from which they are again transferred to another or final support.

Temporary Supports.—Paper, zinc, opal and plain glass, when waxed, are used for temporary supports in the double transfer process.

Development.—The process of clearing or freeing the latent image of the superfluous gelatine and pigment, that had not been affected by the action of light, with hot water.

Reticulation.—The appearance of a fine black net-work over portions and sometimes the entire surface of the picture.

Granularity.—Coarse and grainy appearance of the picture.

Insolubility.—The tissue has lost the property of being any longer soluble in hot water.

Fixing or Hardening.—The film is hardened or made insoluble in a solution of alum, formalin, or sulphate of aluminum.

Reversed Negatives.—Negatives having the image reversed by means of a prism or reversing mirror; or the film of an ordinary negative is inverted, for the purpose of giving correct picures by the single transfer process.

Inverted Prints.—Pictures made by the single transfer process, from ordinary non-reversed negatives.

Prism.—An optical instrument used in front of a lens to invert the image of a negative which is intended to be used for single transfer pictures.

Reversing Mirror.—A mirror silvered on an optically plane surface; used in front of the lens for the purpose of reversing the image of a negative, for single transfer printing.

Polychrome.—A positive composed of several films of different colors, accurately registered so that one color blends into the other and forms a picture in the colors of nature.

Carbon Reducine.—A reducing agent used to clear up dark or over printed carbon pictures.

Antichrome.—A chemical compound used to clear up and eliminate all traces of bichromate remaining in the film, before or after development. The best known preparation to give brilliancy and pureness of tone to carbon pictures.

Accelorine.—A chemical preparation added to the bichromate bath that imparts better keeping qualities to the tissue and renders it readily soluble in water of a medium temperature. It also has the property of greatly reducing the continuous action of light in exposed tissue and imparts a greater brilliancy to the tone of the picture.

Chromic Sensitizer.—A new sensitizer used for tissue wanted for immediate use or for hot weather printing.

Celluloid.—Used as a support for pictures with a matt surface. It is made in several tints and grades of thickness 10/100, 15/00, and 20/100, in.; in sheets 20x50 in.

Alba Plates.—White enameled plates, with a surface closely resembling celluloid or porcelain.

Opal or Poreclain Glass.—Opal glass is fused with either an oxide of zinc or tin, and closely resembles porcelain. It is obtainable both with a ground or a polished surface. The ground surface lends a beautifully soft, matt finish, to the carbon picture.

Superimposing Films.—Transferring and developing several films of different colors, one over the other, causing

them to blend together and thus producing pictures in several different colors.

Vertical Developing Tank.—A tank in which carbon prints are suspended in a vertical position during the process of development.

Transferring Machine.—An apparatus used for the purpose of intimately uniting tissue and support previous to development, or mounting prints on their final support.

Gum Bichromate Process.—A direct carbon process in which the pictures are developed from the front without transfer.

Ozotype.—A carbon process without transfer invented by T. Manly.

Sawdust Process.—The process of developing Artigues velvet paper by means of a solution of fine sawdust in hot water.

Photo-Oleograph Process.—A process for making pictures in colors by the aid of photography; invented by A. M. Marton in 1885.

MATERIAL AND REQUISITES OF THE PROCESS.

Although carbon pictures may be made in a small way, that is, having little or no equipment other than a couple of trays, a squeegee, and a thermometer; it nevertheless requires a more respectable outfit to carry on business to any considerable extent. Therefore, unless a carbon printer is equipped with the necessary material and apparatus, he can not be expected to do very satisfactory work, or do it at all, without considerable loss of time and material.

The following list of materials, apparatus, etc., will be sufficient to supply any carbon plant of ordinary capacity:

One broad camel's hair brush, a large and small drag squeegee, one squeegee board, a large and small rubber cloth,

a large and small piece of transparent (thin) celluloid, a zinc or porcelain sensitizing tray, a tin mounting tray, two tin cold water trays, one porcelain or rubber alum tray, one hot water or developing tray, one dipper, one thermometer, one actinometer, two dozen photo clips, one set of rubber finger tips and a pair of rubber gloves.

If the tank method of development is adopted it will require one hot water, two cold water, and one alum tank, of a size suitable for the class of work to be turned out. It will further take opal, ground glass and paper temporary supports, enough to answer the purpose, squeegee plates, waxing solution, cotton flannel, one chamois skin, six or eight lead weights, tin pressure boxes for tissue, tin receptacle, a small gas stove, negative racks. In the majority of cases the above named articles, apparatus, etc., are of course already in use in the studio and will not need to be supplied.

The following list of chemicals are required for making single and double transfer carbon pictures:

Bichromate of potash, granulated
Carbonate of ammonia.
Chloride of sodium
Carbon reducine
Bichloride of mercury
Permanganate of potash
Sulphite of soda
Powdered potash alum
Chrome alum
Liquid ammonia
Antichrome
Sulphocyanide of ammonia
Accelorine
Chromic Sensitizer
Sulphuric ether
Hydrochloric acid
Hydroflouric acid
Fluoride of soda
Collodion
Benzole
Turpentine
Alcohol
Gelatine
Rosin
Pure beeswax
French chalk
Talcum
Glycerine.
Columbian Spirit

MATERIALS USED.

The following list of carbon tissue, transfer paper, etc., is used for the ordinary run of carbon pictures:

Warm black	Photo-purple
Engraving black	Red chalk
Standard brown	Sea green
Sepia	Marine blue
Ruby brown	Platinum black.
Italian green	Cool Sepia

Matt surface celluloid, opal glass, single transfer paper, baryta paper and etching paper for single transfer; and final support, and opal or poreclain plates for double transfer pictures.

〔注意〕

1. 左記の薬品順に漏れなく全部求め置くこと。
2. 危険薬品は別々保管し又取扱に注意すべき事。
3. 薬品保管戸棚は水分又直接日光の方々に置く事。

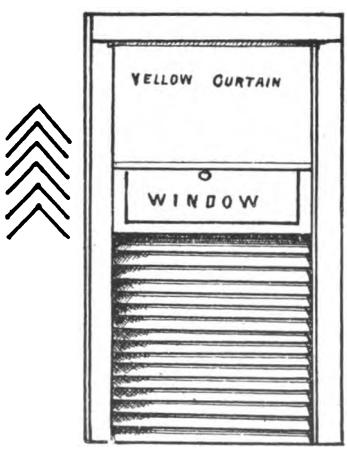
以上。

CHAPTER IV.

THE WORK-ROOMS.

IF THE real cause of many failures in carbon printing were known, it would undoubtedly be found that the rooms and light where the work had been done were at fault.

There seems to be a lack of understanding regarding this very important matter, and I would like to impress it upon the minds of all beginners who contemplate making arrangements for carbon printing, that a properly arranged work-room, with the necessary apparatus, etc., should be the first consideration.



DOUBLE SHUTTERS.

The requirements are nothing elaborate or expensive. All that is necessary is cleanliness, plenty of pure, fresh air, and everything in its place at the proper time. Without these it would be utter folly to undertake work of this kind and expect to be successful.

Ordinarily the work-rooms need not be any different from those used for common photographic printing purposes. The only important difference is in the light which must be subdued by an arrangement of shutters,

or screened with yellow glass or curtains. This is absolutely necessary at all times when dry sensitive carbon tissue is exposed, like in the cutting and changing operations.

THE DRYING ROOM.

The first difficulty experienced by a new beginner in carbon printing, is to find a room that can be properly arranged for drying sensitized carbon tissue.

The requirements for this room are, perfectly dry walls and floor, with a ventilation that furnishes a good supply of pure, fresh air. The absence of soot, dust, foul gases, and stench of any kind, is all important and must absolutely be avoided.

Painted walls and painted floors are easily kept clean, on account of retaining but very little moisture, and are therefore especially recommended.

The source of light must be arranged so that it can be shut out completely during the process of drying without shutting off the draught. (See Fig. 1.)

THE DEVELOPING ROOM.

This room may be arranged to suit the convenience of the operator; usually a toning room with a window fixed as in Fig. 1 will serve the purpose for an ordinary amount of work. Perfect cleanliness in all parts is absolutely necessary to insure success. Tables, trays, and tanks of every description must be in good order to avoid a hitch and cause failure.

PURE AIR AND VENTILATION.

The double shutter arranged on the outside and lower part of a window. Fig. 1 is probably the best arrangement that could be devised for the purpose of supplying light, and ventilation to a carbon plant. These shutters are so ar-

ranged as to allow the window to be raised and lowered at will, and serve to shut out all the white light, but will admit the air to pass through freely. Grates and chimney flues also serve this purpose, but are not so effective.

One of the most important factors in carbon printing is pure, dry air. There may be the best kind of ventilation and yet the required pureness may be wanting.

Rooms located near water closets, stables, factories, etc., emitting bad odors or foul gases, must be avoided, especially when drying sensitive tissue.

THE LIGHT.

The most important operations in carbon printing are carried on in a non-actinic or subdued daylight. Only the latter part of the developing manipulations require a good, strong light to enable the operator to distinctly observe the appearance of the latent image as it emerges from beneath the mass of pigmented gelatine during the progress of development.

Of all the arrangements in use for the purpose of supplying light and ventilation to a carbon plant, the one given in the accompanying cut, Fig. 1, is one of the most simple and probably the most practical in use.

The curtain, which should be of orange colored fabric, or yellow Holland, should be made to slide in grooves at the sides, to completely shut out all the white light that might enter from that source. The shutters are painted red or yellow, to make the light reflected through them non-actinic. For work at night, the Welsbach incandescent gas burner makes a fine light to work by.

For a light to use during the sensitizing operations a sperm candle is probably the safest and best. The smell of gas or kerosene has a ruinous effect upon the tissue.

CHAPTER V.

THE CARBON OR PIGMENT TISSUE.

CARBON tissue, as I have previously explained, is a paper coated with a pigmented gelatine. This tissue was originally prepared with lampblack or india ink, which is chiefly pure carbon; hence the name "Carbont Tissue." The manufacturers of the present time, have introduced a great variety of colors, of which many are mineral oxides and it would hardly be proper to put them under the head of carbon; hence the name "Pigment Tissue." The products of the manufactures are of a most excellent quality and readily obtainable at any stock house. The colors most popular at the present time are: Warm black, engraving black, platinum black, sepia, lambertype purple, sea green, and bartollozi red. The range of colors of the different makes, embraces about forty different tones or colors, and is obtainable in rolls of thirty square feet.

Although pigment tissue is cheaply and very readily obtainable, there are quite a good many carbon printers who prefer to make their own tissue. I will therefore, give full instructions in the manufacture of carbon tissue. (See appendix.)

THE CARBON TISSUE—ITS CONDITION AND APPEARANCE RELATIVE TO ITS PRINTING QUALITIES.

It is quite difficult to judge the quality of carbon tissue by its appearance. The gelatine, pigments, and different chemical ingredients that enter into its general makeup, all

have more or less influence upon the appearance of its surface. Thus, a film composed of an inferior grade of gelatine, or the addition of a considerable amount of sugar, will appear brilliant and glossy when looked at by reflection, while another prepared with a finer grade of gelatine will have a matt, dull surface, and not be so pleasing in appearance, and yet be a superior grade of tissue. Therefore, the quality of a carbon tissue should never be judged by its brilliancy or gloss, for a tissue having a fine, glossy appearance may yield very unsatisfactory results, while another, with probably an uneven and apparently lifeless surface may yield pictures that are brilliant and vastly superior in every respect.

The paper used as a support for the pigmented gelatine compound, also has a considerable influence upon the appearance of the film. A tough, smooth paper gives an even surface, while a soft, spongy paper produces an uneven, pebbled appearance. The latter is sometimes difficult to strip from the film, especially when the tissue has become a little old and probably partly insoluble.

Commercial carbon tissue usually has a smooth, uniform coating; but it does not matter materially, however, if it does contain places of uneven thickness. The formation of the latent image takes place in the immediate surface of the film, to a depth according to the penetrating power of the light to which it was exposed. If the exposed tissue remains undeveloped for a considerable length of time, or is left to the influence of the continuous action set up by the exposure to light, it will gain considerable in density and if not arrested, goes on until it passes clear through the entire film, causing total insolubility and loss of tissue.

The superfluous compound that remains beneath the unaffected portion of the film is of no more consequence than to

merely help the easy removal of the paper from the back of the tissue and otherwise facilitate the development.

Considering the hygroscopic nature of gelatine, carbon tissue should be well protected against the humidity of the atmosphere, and be stored in a perfectly dry and cool place.

The gelatine film itself is not materially affected by moisture, any more than it would cause it to stick together.

The only damage caused by moisture is the formation of mold on the paper supporting the film, which in time would affect the gelatine and cause it to rot and completely destroy the tissue.

CHAPTER VI.

BICHROMATE OF POTASH.

THE application of nitric acid to chromate of potash yields bichromate of potash which is rendered clear of impurities by crystallization. It has two atoms of acid to one of base, which occur in fine orange colored crystals and are soluble in about twelve parts of water at 58° F.

Light decomposes the chromic acid of bichromate of potash when in contact with an organic body, such as gelatine, gum, starch, etc., by yielding up half of its oxygen to the organic body; itself being reduced to a lower oxide of chromium. Through oxidation by the chromic acid, the organic body is rendered insoluble in hot water, to a degree acted upon by the actinic rays of light. Upon this property is based the carbon process and the various photomechanical printing processes.

BICHROMATE OF AMMONIA.

Bichromate of ammonia is obtained by treating chromic acid with ammonia and evaporating. The crystals thus formed are freely soluble in water, and it is claimed by some that it imparts a greater sensitiveness to the tissue and more vigor and contrast to the prints, otherwise it has about the same properties. Its cost is more than double.

BICHROMATE OF SODIUM.

Bichromate of sodium is highly recommended as a substitute for bichromate of potash, or ammonia. It will be found

to have some very excellent qualities. Being freely soluble in water, it does not crystallize on the film as readily as ammonia or potash. It disolves in double its quantity of water; ammonia and potassium salts require as much as ten and twelve. It is less than half as expensive as the former.

BICHROMATE POISONING.

Bichromate of potash is a corrosive poison, and although cases of bichromate poisoning are rare, it is best to handle it with care. It should never be allowed to touch the hands where there is an abrasion of the skin or a sore of any kind. It causes a severe irritation, which, if not immediately arrested, causes sores and ulcerations that are difficult to heal.

In a powdered state it must be carefully handled to avoid dust, which, if inhaled, attacks the mucous membrance very seriously, causing a violent cough and sneezing, with a suffusion of tears. Immediate application of warm water made slightly alkaline with bicarbonate of soda or magnesium is of the greatest importance. Taken internally, it causes violent inflammation of the stomach and bowels, and seriously affects the kidneys and bladder.

A teaspoonful of bicarbonate of soda in a glass of water should be taken immediately, and at the same time a paste made of two parts of bicarbonate of magnesia and one part of chalk, mixed in water, should be prepared, to be taken in case the bicarbonate of soda does not have the desired effect.

To avoid trouble caused by an abrasion of the skin, or by absorption while developing in hot solutions, wash the hands well with common laundry soap, and apply a carbolated vaseline. In severe cases, a salve sold by all druggists, called "carbolisalve," will heal it in a very short time.

There are quite a number of chemicals used in photography which are probably more dangerous than bichromate

of potash; and yet cases of poisoning are very rare. So with the bichromates; but it is best to be posted on the dangerous properties of these chemicals, so as to be able to guard against trouble which might be incurred by careless handling.

The safest and best plan, when using these chemicals, is to wear rubber gloves, or at least rubber finger cots.

Spermaceti, or beeswax, dissolved in a little turpentine, will protect abrasions or sore places while working in cold solutions.

CHAPTER VII.

THE BICHROMATE SENSITIZING BATH.

THE bichromate sensitizing bath is the one all-important chemical solution employed in the carbon process. Its preparation and constituents greatly depend upon certain conditions, of which the character of the negatives to be printed from, must be the first consideration. The climatic conditions that prevail during the different seasons of the year in the various localities all over the country, must also be taken into consideration.

The strength of the bichromate bath is quite a factor in carbon printing. A strong bath will make the tissue very sensitive to light (from three to six times more than Aristo,) but it will have a tendency to flatness and soon becomes insoluble. A weak bath makes the tissue less sensitive to light, but it will print with considerable more contrast and also has much better keeping qualities.

Therefore, when preparing the sensitizing bath, it is well to bear in mind that we must gauge the strength of our solutions according to the temperature of the atmosphere, and the density of the negatives to be printed from.

From the above it will readily be seen that when we have negatives strong in contrast and very dense, we will require a strong solution, one that will make the tissue very sensitive to light and will print with a tendency to flatness; which will reduce the harsh contrast of this class of negatives, and yields softer and finer prints. An unduly strong bath should, however, be avoided, as it has a tendency to make the gela-

tine film insoluble without exposure, especially in hot weather. On the contrary, if our negatives are weak and delicate, with a tendency to flatness, and we desire prints with more brilliancy and contrast, it is obvious that we must adopt a formula with a small per cent of bichromate, to accomplish the desired result.

A three per cent solution of bichromate is the average strength of bath used for sensitizing commercial carbon tissue, at a moderate temperature, for negatives of medium strength.

The speed, providing the bath is new and contains nothing that will retard the action of light, will be from three to four times as rapid as Aristo paper. During the winter months, in northern climes when the light is weak and dull and the action is very slow, it is necessary to increase the strength of the bath to a five or six per cent solution, and in some instances, as high as seven or eight per cent, for negatives of unusual density, to be printed in a very low temperature.

In localities where the temperature gets very low and the light weak, it is advisable to make thin negatives; under such conditions the results will be far better than from dense ones.

With the gradual rise of the temperature in spring, until the heat reaches its maximum intensity in summer, we gradually reduce the strength of the bichromate bath to a two per cent solution, and when the negatives are thin and weak it is sometimes necessary to reduce it to a one per cent solution to obtain the desired results.

In hot, moist climates, the tissue is liable to become insoluble while drying, if the proper precautions are not taken.

To counteract this tendency, it is advisable to reduce the strength of the bath and add a small quantity of pure car-

bonate of soda; this should, however, never be used to excess. A small quantity will prove very beneficial, while an over-sufficiency is very apt to cause trouble.

There are other means to help overcome this difficulty. An addition of alcohol, and in some cases ether, will keep the tissue in a good, workable state and prevent a too rapid insolubilization. Accelorine imparts fine keeping qualities to both bath and tissue, but with its use the alcohol must be omitted.

For tissue for immediate use, in sheets of small form, our new chromic sensitizer, is the finest bath there is. The tissue is sensitized, dried and ready for use in from five to ten minutes, and yields very superior prints.

The purity of the water used in making up a sensitizing bath, is also of considerable importance in producing a highly sensitive and easily soluble tissue. Pure spring or well water, unless it is excessively hard, will answer very well, if it is first boiled. Rain water is usually more or less contaminated and contains considerable organic matter, but it possesses the required softness. The simple process of boiling it in a clean vessel will purify it by precipitating the organic matter which makes it most suitable to use for bichromate sensitizing solutions. A bath made up of distilled or boiled rain water, will not dissolve so readily, and the sensitized tissue will develop quickly and will yield clean, clear and brilliant prints, and, furthermore, will have good keeping qualities.

A good quality of bichromate, and good pure water is really all that is required for a good sensitizing bath. All other additions are made to improve the quality of the tissue in one way or another, some to make it more pliable, and others to make it easily soluble in water of a moderately low tem-

perature, or to make it print with more contrast, and to give it better keeping qualities, etc.

The temperature of the bichromate bath is another very important factor in sensitizing carbon tissue. This depends greatly upon the climatic conditions that prevail during certain seasons of the year in different localities or sections of the country. In winter the temperature of the bath should never be below 60° F. or higher than 70° F. In summer it must be cooled down to 50° F. and never allowed to be above 60° F. It is well to bear in mind that gelatine is much easier soluble in a solution of bichromate than it is in plain water of the same temperature, and therefore must be kept as cool as possible in summer. If the temperature of the room is high, some means must be provided to keep the solution cooled down to the proper degree. A tray of cold water, or broken ice, in which to set the sensitizing dish, is probably the most simple manner of accomplishing this purpose. A solution of chemically-pure bichromate in distilled water will not be decomposed by light and will keep indefinitely.

In presence of an organic substance, however, such as alcohol, sugar, glycerine, gelatine, etc., light will reduce the chromic acid of bichromate of potash very rapidly, and it will first turn brown, and then assume a greenish color, and it will finally be reduced to green oxide of chromium.

It does not lose its tanning property, however, but if used in this condition as a sensitizing agent for carbon tissue, the pictures resulting therefrom will be weak and gray, blacked in the shadows, and will be very difficult to develop. Furthermore, the tissue will not keep and sometimes becomes insoluble during the process of drying.

It is, therefore, well to remember that all bichromate solutions containing organic matter, carbonate of ammonia, alcohol, etc., must be preserved in dark-colored bottles or

jugs, or must be kept in a dark place, and that it is not wise to use a bath too long. It is better economy to renew it too often than not enough. Bichromate of potash is cheap and easily obtainable.

The manner of mixing, or making up, a sensitizing bath, will, of course, be left to the convenience of the operator. The granular bichromate may be dissolved in hot water and filtered, or it may be tied into a small bag and suspended in a wide-mouthed jug or bottle containing filtered hot water, where it will readily dissolve, and the sediment or insoluble particles are left remaining in the bag.

When the solution has cooled down to the proper temperature, add the ammonia, glycerine, alcohol, etc., according to prevailing conditions of temperature and atmosphere, and the quality of negatives for which the paper will be used.

The following formulas have been tested and tried and are used by many of the foremost carbon printers of this country, and of Europe:

No. 1.

Bichromate of potash	3 ounces
Water	100 "
Carbonate of ammonia	70 grains

If the negatives to be printed are thin and flat, add one ounce of glycerine to give contrast.

In summer, reduce to a two per cent solution, and add 4 ounces of alcohol.

To prevent reticulation in hot weather, add 100 grains of salicylic acid, or a few drops of a 10 per cent solution of bichloride of mercury. In extreme cases, coat the tissue with a 1½ per cent collodion.

The time of immersion for negatives of medium strength is three minutes, and for thin negatives, two minutes.

The following is a splendid bath for heavy, dense negatives, with violent contrasts, and for use during cold weather in the winter season:

No. 2.

Bichromate of potash, C. P.	6 ounces
Distilled water	100 "
Accelorine	150 grains
Ammonia (Liq.)	2 drams

Dissolve in hot water and filter through fine muslin.

Time of immersion: Heavy dense negatives, 4 minutes; medium negatives, 3 minutes.

The following is a very fine bath, and may be used in any climate, giving splendid results from all classes of negatives:

No. 3.

Bichromate of potash	2 ounces
Bichromate of ammonia	2 "
Ammonia (Liq.)	2 drams
Accelorine	100 grains
Water (distilled)	128 ounces

In summer, dilute with an equal quantity of water and add from 2 to 4 ounces of granulated sugar. Rapid drying is essential in warm weather.

Time of immersion: Thin delicate negatives, 2 minutes; medium, 3 minutes, and dense contrasts, 4 minutes.

FORMULAS FOR SPECIAL PURPOSES.

The following bath, if properly managed is especially recommended for summer use, and for excessively hot and dry climates:

Bichromate of sodium	2 ounces
Water	100 "
Ammonia (Liq.)	120 min.
Citric acid	100 grains
Salicylic acid	50 "

Time of immersion: Medium negatives, 3 minutes; thin negatives, 2 minutes

The above bath must be kept in a cool, dark place.

A bath especially adapted for tissue to be used in hot, moist climates, may be prepared as follows:

Water	100 ounces
Bichromate of ammonia	1 ounce
Bichromate of potash	1 "
Carbonate of soda (C. P.)	100 grains
Strong ammonia (Liq.)	2 drams

Dissolve the bichromate in the usual way and add the ammonia and carbonate of soda. Then pour 2 ounces of alcohol into 3 ounces of sulphuric ether and add the mixture to the bath.

The tissue sensitized in this bath will dry out quickly and is readily soluble in water at a moderately low temperature.

BATH FOR CARBON VIGNETTES.

The difficulty experienced by some carbon printers in obtaining delicately graded vignettes, may be attributed, in part, to the bichromate bath. A solution composed of the following constituents, makes a bath that will impart to the tissue, the qualities desirable for this purpose:

Bichromate of potash	8 ounces
Water	120 "
Strong ammonia (Liq.)	3 "
Accelorine	1 ounce

For more vigorous effects dilute with water.

Immerse the tissue two and three minutes according to density of the negative.

This bath has all the fine qualities desirable in a good bichromate sensitizing bath, and may be readily adjusted to suit any class of negatives with the additional advantage of delicate gradation in vignetting.

The age of the tissue will, of course, have considerable influence upon its condition and printing qualities, working with more vigor and contrast when new, and having more delicacy and softness when several days old.

CHAPTER VIII.

PRACTICAL NOTES.

ALL the chemical constituents of a bichromate bath, their behavior, agency and purpose should be well studied by both amateur and professional carbon printers, to enable them to fully understand the working details of the process. I will, therefore, briefly refer to a few of the most important constituents, upon which it is well for the carbon printer to be posted.

A good quality of bichromate and pure water is really all that is necessary to make a sensitizing bath; all the other ingredients are added to ameliorate the faults of both tissue and negatives, and to overcome the difficulties brought on by certain conditions of climate and temperature.

A concentrated solution of bichromate will make the tissue very sensitive to light, and will therefore become very readily insoluble.

Being extremely sensitive causes it to print with a tendency to flatness, which for that reason makes it very suitable for negatives that are dense and contrasting, but on account of its extreme sensitiveness, it will not keep in a good workable condition for a great length of time.

Newly sensitized tissue prints with vigor and contrast. With age it becomes less contrasty and gives softer effects; and when old, unless the negatives possess the required strength, the prints will be flat and lifeless. It will thus be seen that old tissue is just the article for hard contrasty negatives, and new tissue for thin, soft negatives that have a tendency to flatness.

Carbonate of ammonia makes the tissue more pliable and readily soluble in warm water, and in a measure stays the tendency to insolubility, and thus adds to its keeping qualities.

The amount used may be varied according to existing conditions; from a half to one grain to each ounce of bath, according to the strength of solution.

Liquid ammonia (.880) is preferable to carbonate in hot, moist climates.

It is used from a half to five per cent, according to climatic conditions and per cent of bichromate contained in the solution.

Carbonate of sodium is preferred by a great many to carbonate of ammonia. Its action is milder and the pictures are finer, but it slows the tissue considerably more than the ammonia.

Glycerine makes the tissue very pliable and causes it to adhere better to the support, and also makes it easily soluble during development, but it must be used with care; while it gives contrast and greatly adds to the vigor of the prints, it will also cause a loss of half-tones, and considerably retards the action of light upon the tissue. Use from a half to one per cent.

Salicylic acid about one grain to the ounce of sensitizing bath (3 per cent) may be added in summer to improve the keeping qualities, and prevent reticulation.

Sugar is sometimes used instead of glycerine; it makes the tissue pliable, easily soluble in hot water, and adds vigor to the prints. Use from one to four per cent.

Alcohol is used solely for desiccating purposes—hastening the drying of the tissue. The amount used varies according to temperature and other atmospheric conditions, from two per cent in winter to twelve, and in some instances as high as twenty per cent in the hot days of summer.

Carbon tissue immersed in a bichromate bath containing a high per cent of alcohol, will not imbibe as much solution as if immersed in a plain bath; therefore it will dry more rapidly, especially, if placed in a draught.

Alcohol affects the keeping qualities of the tissue somewhat, however, in that it hastens insolubility. It is therefore advisable to use the tissue while it is fresh, and develop as soon after printing as possible.

Ether (*sulphuric*) mixed with one part of alcohol affords a special advantage as a drying agent for carbon tissue in southern climes, especially where the atmosphere is hot and moist. Add from 4 to 6 per cent of the mixture.

Bi-chloride of mercury in a ten per cent solution is used to prevent reticulation in the hot days of summer. Must be used with care; if used in excess it will produce insolubility. Mercury has a tanning action on gelatine.

Chromic acid. A small proportion of chromic acid is sometimes added to the sensitizing bath for tissue of very high speed.

Yellow chromate of potash (*neutral*) is used for slow tissue or where great contrast is desired.

Sulphate of manganese is also used as an addition to the bichromate bath for tissue of high speed.

The temperature of the bichromate bath should be kept between 50° and 60° F. in summer, and 60° and 70° F. in winter.

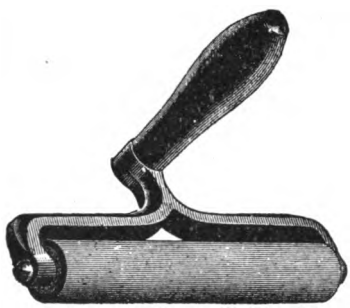
Bichromate solutions containing alcohol, glycerine, etc., must be kept in a dark, cool place.

Accelorine.—The addition of this compound to the bichromate bath improves the keeping qualities, and materially adds to the speed of the tissue, and further, makes it readily soluble in water of a moderately low temperature and gives greater brilliancy of the image. A high per cent of alcohol used in connection with accelorine, will cause precipitation. It must therefore be used with care.

CHAPTER IX.

THE SQUEEGEE.

THIS little instrument takes quite an important part in the carbon process. All the transferring operations are done with either roller or drag squeegee.



ROLLER SQUEEGEE.

Many operators prefer to use a thin, flexible scraper of wood or rubber, instead of the rubber squeegee. I cover the transfer with a thin piece of celluloid and use the flexible wood scraper over it as I would the squeegee, and in that way can do the work more effectively and better than with the ordinary squeegee. The drag squeegee must always be used in transferring the tissue to the support before development.

DRAG SQUEEGEE.

There is quite a knack in using this tool to the best advantage. If the beginner will observe the effect of the squeegee upon his pictures, he will see dark streaks and cloud effects, caused by too much or uneven pressure. Striking the squeegee down hard when placing it across the back of the tissue while making the transfer will leave a plainly noticeable streak. A machine constructed on the principle of a clothes wringer may be

used to good advantage in transferring a large number of prints. If properly made, it does the work well and saves considerable time and labor.

RUBBER CLOTH AND THIN CELLULOID.

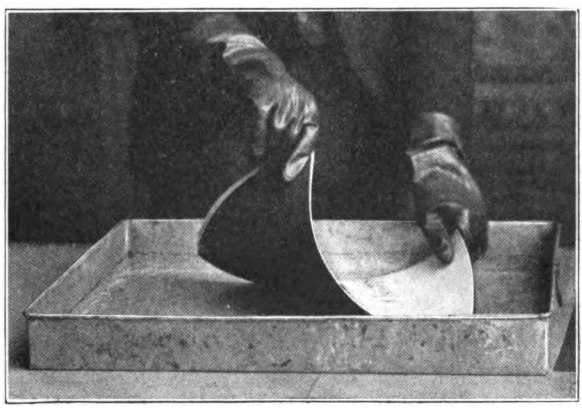
The squeegee and rubber cloth are closely allied in working the carbon process. The rubber is spread with the cloth side up, over the print in the transfer operation, to prevent the squeegee from roughing up or tearing the paper.

Thin, transparent celluloid is used for the same purpose and is less troublesome to handle than rubber cloth.

When using the celluloid, a thin, flexible scraper made of wood or rubber, may be used instead of the regular squeegee. It does the work thoroughly and is much easier to manipulate.

CHAPTER X.

SENSITIZING THE TISSUE.



SENSITIZING OPERATIONS.

ESTABLISHMENTS that manufacture their own carbon tissue, will find it a great advantage to incorporate the bichromate or sensitizing agent into the pigment emulsion, of tissue they intend for immediate use. It will save considerable time, and require less handling, but of course, this kind of tissue wi l keep only for a limited time—from four to ten days,

Ordinary carbon tissue is made sensitive to light in a solution of bichromate of potash, of a given strength. This is one of the most important operations of the process and it should be done with the utmost care in every detail. Although there is nothing difficult or complicated about it, it nevertheless requires care and good judgment, to properly

adjust the strength of solution to the quality of the negatives to be printed from, to obtain the best results.

Our new chromic sensitizer is probably the most simple and economical sensitizing bath for carbon tissue in use. It is applied to the surface of the tissue with a soft brush or sponge, and dries out very rapidly; if necessary, it can be dried and ready for use in five minutes. This bath is, of course, intended for tissue for immediate use.

There is quite a diversity of opinion among expert carbon printers in regard to which are the best methods for obtaining the proper degree of sensitiveness of the tissue, to suit the printing qualities of negatives of different densities. Some employ solutions of different strength, for thin, or for heavy negatives, as the case may be; others claim the same results by longer or shorter immersion of the tissue in a sensitizing bath of normal strength.

It will thus plainly be seen that there is really no fixed rule to follow in sensitizing carbon tissue, with the exception of that of judging how much bichromate of a given strength a film should be allowed to absorb, to bestow a sensitiveness capable of producing a brilliant picture from a negative of certain strength and quality.

It is therefore well to bear in mind that the greater the proportion of bichromate the tissue is allowed to imbibe, the more sensitive it will be; be it through a long immersion in a weak bath, or a shorter length of time in a solution of considerable strength.

As we have previously noted, tissue that has been sensitized on a strong bath, on account of having absorbed a great deal of bichromate, will be found very sensitive, and will be best suited for dense or slow printing negatives. But the keeping qualities are not so good; for it rapidly deteriorates, especially in warm weather, when insolubility sets in and destroys its printing qualities in a few days.

Tissue that has been allowed to absorb but a small amount of bichromate has much better keeping qualities, but is considerably less sensitive. On that account it is better suited for thin, delicate negatives that require a tissue that prints with considerable contrast.

This quality of tissue is obtained by a short immersion in a bath of medium strength, or the use of a weak solution.

It is also possible to alter the printing qualities of carbon tissue by floating either film or paper side upon the sensitizing bath. Floating on the film side produces softness, and, on the other hand, floating it on the paper side gives contrast and more vigorous prints.

Although newly sensitized carbon tissue is but slightly affected by light while in a wet state, it is nevertheless good policy to use a subdued or a yellow light when performing this operation during the day.

A sperm candle is probably the safest light to use when sensitizing tissue in the evening, on account of all absence of smell or bad odors. The smell of gas or kerosene has an injurious effect on sensitive tissue.

The room in which this operation is performed must be as cool as possible in summer; and should have a temperature of about 70° F. in winter. It must have a good ventilation, and be as free from dust as possible. The sensitizing tray may be of zinc, glass or porcelain; the latter is preferable, if not too expensive. For the common run of studio work, a tray 18x22 inches in dimensions will answer all requirements; but there is no restriction as to size, it may be large or small, to suit the convenience and purpose of the operator. Where carbon printing is carried on extensively, it is a very good policy to sensitize the tissue in large sheets; it saves time and less handling.

In summer the sensitizing tray must be placed into a

larger tray containing ice or ice water, to keep the solution cool and at an even temperature. This tray may be made of galvanized iron, or, for economy's sake, may be of wood, lined with oil-cloth or rubber.

Place the tray on a convenient stand or table, near a good strong, but yellow light, so as to be able to plainly see the surface of the tissue during the process of sensitizing. Then pour in the bichromate solution, which of course, has been previously well filtered, and the strength adjusted to the density or printing qualities of the negatives it is intended to print from.

The solution should stand at least one and one-half inches high, in the tray, and have a temperature ranging between 50° F. and 60° F. in summer and between 60° F. and 70° F. in winter.

The lower the temperature of the bath in summer, the less liable the tissue will be to reticulate, and the finer will be the quality of the pictures. The higher it is, the quicker will the solution be absorbed by the gelatinous coating, and the more liable will it be to cause reticulation or coarse, grainy prints.

There are no specified sizes, into which the carbon tissue should be cut. The roll is 30 inches wide, and if a strip 18 inches wide is measured off, and again cut through in the middle, we have two pieces of 15x18 inches; a very convenient size to handle. When ready to begin with the sensitizing operations, protect the hands with rubber gloves or finger cots, on account of the poisonous nature of the bichromate and its injurious effect upon the skin. Then remove the dust from both sides of the tissue with a camel's hair duster, and taking it by the corners diagonally opposite, place it upon the sensitizing bath

RUBBER FINGER COTS.

and immediately push it under the surface of the solution with a flat camel's hair brush or sponge.

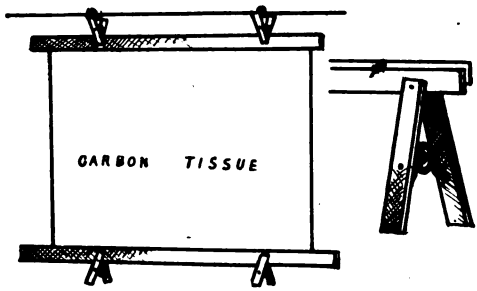
RUBBER GLOVES.

Rock the tray gently and remove all the air-bells and scum that gathers on the back of the tissue with the camel's hair brush or sponge. In about one minute, or as soon as the gelatine film has absorbed enough of the solution to flatten it out, turn the tissue over and pass the brush gently over the entire surface of the film, to remove all the scum or air-bells that might adhere thereto.

Then again turn it face down, carefully avoiding any violent disturbance of the solution, which would cause air-bells, and always keep the tray in gentle motion.

PHOTO CLIP.

At the end of about three minutes the tissue will have flattened out and will begin to show signs of curling backward. At this stage it must be taken from the solution, and, after well draining, lay it face down upon a clean plate of glass somewhat larger than the tissue. (In summer keep this glass cool. A good way to do this is to immerse it in cold water, and just before using it remove the water with a soft rubber squeegee, then pass the squeegee over it from center to side and remove all the superfluous solution.) Then with a clean, dry blotter and roller squeegee, or, if preferred, a clean dry sponge remove all the remaining moisture, especially around the margin and sometimes on the surface, to insure a uniformly even surface of the tissue when dry.



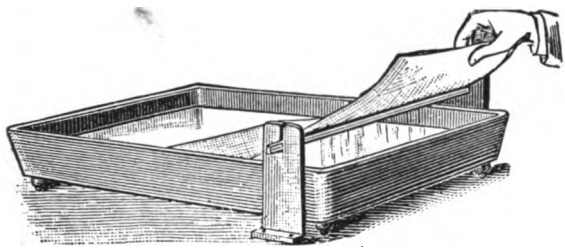
SLATS ATTACHED WITH PHOTO CLIPS.

The tissue is then immediately taken from the glass and placed into a stretcher or after fastening slats to top and bottom with photo clips (Fig. 10), it is hung up to dry. In England, the most common mode of drying a carbon tissue, is to lay it over a curved cardboard like in Fig. 11. The above methods are ordinarily employed for the common run of studio work, and are sometimes employed in large establishments.

An English manufacturing concern has recently modified their method of sensitizing carbon tissue. They immerse it in the usual way, but only for one minute, and then attach slats to top and bottom and without squeegeeing hang it up to dry. Wall uses a five per cent solution of bichromate and dips his tissue for 30 seconds in summer and 45 seconds in winter, and without squeegeeing hangs it up to dry. He further advises the operator not to let the temperature of the bath exceed 79° F. (rather high) he probably meant 69° F.

Drying tissue on a squeegee or ferreotype plate, is probably the very best and most practical way to handle a moderate amount of material. Drying it in this manner, the film is protected from dust and all injurious gases and vapors that might be present, and when it leaves the plate its surface is as smooth as glass, and will give perfect contact to the nega-

tive, and thus insure a picture as sharp as the negative will make it.



DRAWING TISSUE OVER GLASS ROD.

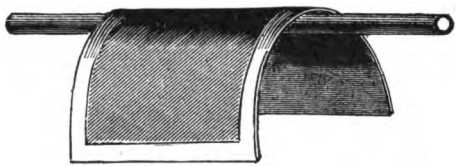
For carbon printing on a large scale, a machine may be constructed, which will sensitize tissue as it comes from the roll, and saves a great deal of time and labor.

The tissue passes from the roll into the solution at a speed which, at a given length of time, passes it through the solution and out at the opposite end, where it passes between two soft rubber rollers that do the squeegee act on the principle of a clothes wringer. The tissue enters into the solution face upwards and passes over a flannel pad on the bottom of the tray. The scraping action of the flannel prevents any froth or air-bells from forming on the back of the paper, while the face is kept clear with a broad camel's hair brush in the hands of an assistant. When the entire roll has passed through the solution, it is hung up in festoons in a properly constructed drying-room, having a good fresh air supply, a ventilator or exhaust fan driven by electricity or a small water motor, will keep the air changing and will dry the tissue quickly. If the air is laden with moisture a tray of lime or chloride of calcium must be placed in the fresh air supply; and the air filtered through gauze.

The temperature of the room ought to be about 70° F. Of course it stands to reason that all trays containing water or anything that would cause moisture, must be removed from the room.

CHAPTER XI.

THE DRYING OF SENSITIVE CARBON OR PIGMENT TISSUE.



DRYING TISSUE OVER CURVED CARD.

UPON the proper drying of sensitized carbon tissue, depends to a great extent, the successful termination of the development and final transfer of a perfect carbon picture.

The room must be well ventilated and dry, and as free from dust, foul gases or vapors, as possible.

To keep the air pure and in motion, an electric exhaust fan is of valuable service. An open chimney or fireplace will answer, providing the temperature of the room is not too high.

Rapid drying of carbon tissue is very essential in warm weather.

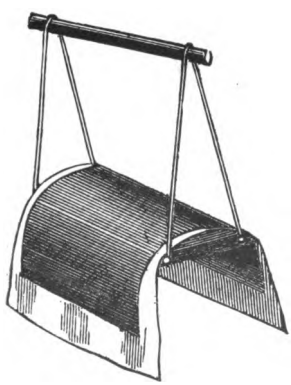


FIG. 11a.

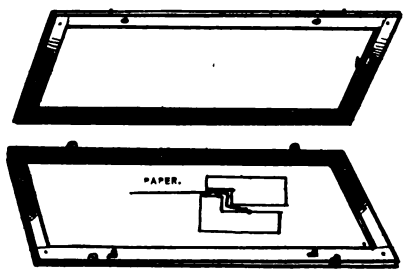
The qualities imparted to a tissue by proper drying are, good adhesiveness to any support or medium; and an easy solubility, which induces a speedy development, and yields vigorous and brilliant pictures, with pure whites and velvety blacks; beautiful half-tones and perfect gradations in all parts of the picture.

The temperature of the drying room must be as low as possible in summer, and if the air is loaded

with moisture a tray containing lime or chloride of calcium must be placed near the tissue.

In the cool days of winter a temperature of 70° F. at the beginning and a gradual increase of 75° F., where it must be maintained until the tissue is dry.

The most simple way of drying tissue is to arrange sheets of cardboard curved like Fig. 11 or a sheet of tin covered with a blotter and arranged in like manner. Immediately after blotting off the superfluous solution, place the tissue face up over the curved cardboard and place it in the air current. Another simple way is to fasten thin slats of wood at top



STRETCHER FOR DRYING TISSUE.

and bottom with photo clips and suspend it on a line, like Fig. 10.

It should be borne in mind that the air near the ceiling has a higher temperature and is drier than near the floor, consequently the tissue should be suspended high up in the room.

Drying tissue on glass or squeegee plates is extensively practiced, and can be highly recommended. It keeps the film from being contaminated, and the plate and tissue may be wrapped up in a porous but opaque paper and placed most anywhere, in a current of fresh air.

There is no prescribed rule that must be strictly adhered

to in sensitizing or drying carbon tissue. The printer must be governed by the character of his negatives as well as the strength of his bichromate solutions.

Paper sensitized in a strong bath should not occupy nearly as much time in drying as that sensitized in a weaker one.

The most essential part about it is, that the tissue be thoroughly desiccated in a pure atmosphere, in the proper length of time required by the strength of the solution used, and the character of the negatives to be printed from.

The length of time occupied in drying, ordinarily requires from three to five hours, and should never be allowed to extend over eight, or less than two hours. Between two and four hours for paper sensitized on a normal bath will be found about the correct time to impart the best printing qualities.

Tissue that has occupied but a short time in drying adheres well to any support and develops readily in water of a moderate temperature; but it is not nearly so sensitive as that which has occupied a longer time in drying. If such tissue is printed upon immediately when dry, especially if dried very rapidly, there will be a lack of gradation or the entire loss of half-tones.

If such be the case, the best remedy is to tint the paper (expose the film side of the tissue to diffused light for a brief period) before it is placed upon the negative; that will invariably remedy the fault and yield the desired half-tones. As the paper grows older this difficulty will disappear, and when about two or three days old it will yield the best results.

Carbon tissue dried slowly is much more sensitive to light, and prints softer than if dried out quickly, but, unless the negatives are strong in contrast, the picture will have

a dull, flat, sunken-in appearance, and the development will be slow and difficult.

When the drying is extended over an unusual length of time, the film becomes insoluble and loses its adhesive properties, and consequently becomes entirely insoluble and worthless. On the other hand, if the tissue is allowed to dry too quickly it will become very brittle and difficult to handle. Its sensitive properties will be greatly impaired, and its excessive solubility will result in the entire loss of half-tones or fine details in the picture, and, in a great many cases it will cause reticulation. Excessive solubility is therefore, by no means a desirable quality, and it will be well to guard against too rapid drying, unless the bichromate bath is at least double strength, and contains a considerable amount of alcohol, and ammonia, and if high speed is desired a little chromic acid or sulphate of manganese would help matters considerably.

A great many carbon printers prefer to sensitize in the evening and leave the tissue suspended until morning, when it is found dry and ready for use by the time printing operations are commenced.

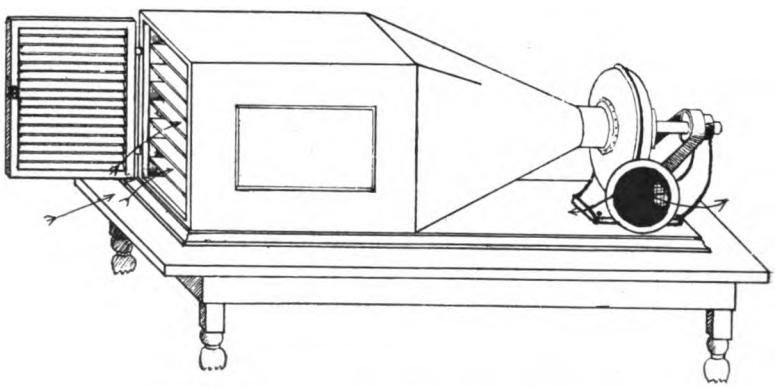
Although this may be a very good plan and all right when the weather is favorable, and the condition of the atmosphere in such a state that it will allow the tissue to become dry in about six or seven hours, I myself think it is best to sensitize at a time when the progress of the drying may be closely watched, and the tissue be taken down as soon as it has become sufficiently dry.

When once dry it should never be left hanging exposed to the influence of the atmosphere, but should be put away in air-tight tin receptacles or boxes, especially if it is to be stored away for future use.

Tin receptacles for storing sensitive carbon tissue should

be made perfectly air-tight, and large enough to permit enough chloride of calcium to be deposited at one end to absorb the moisture, should there be any.

If left hanging too long, the film becomes horny and brittle and is difficult to manage; and when wanted for use, it will be found necessary to hang it over a pan of steaming water to allow it to absorb enough moisture to make it pliable. This never has a good effect on the printing qualities of the tissue, however, especially in warm weather, and should be avoided if possible. Carbon tissue wanted for immediate use may be taken down when quite pliable.



DRYING BOX WITH ELECTRIC EXHAUST FAN.

There are many devices for rapidly drying carbon tissue, of which the following is probably the best: A box or cupboard with shelves arranged like in Fig. 13, has a cone attached to it, at the narrow end of which is placed a ventilator or exhaust fan; at the other end is a double shutter on hinges made to shut out all white light (shutter must be painted red) but admits the air freely. A slide made like the ones in the plate holder of a camera is so arranged as to shut off any space not in use. When the fan is set in motion

the air is rapidly drawn through the cabinet over the surface of the soft gelatine film which causes the moisture to quickly evaporate and thus hastens the drying of the tissue. If the atmosphere contains considerable moisture, place a tray of lime or chloride of calcium in front of the shutters and filter the air by screening the shutters with gauze or cheesecloth.

MARTON'S NEW RAPID PROCESS

OF SENSITIZING AND DRYING CARBON TISSUE.

Not until recently, has the carbon process been available for quick or immediate work, on account of the prolonged drying, and the time necessary to bring the tissue into proper condition for printing.

There has been much experimenting done within the past few years, to overcome this one objectionable feature of the old process, and it affords me great pleasure to say that this has now been accomplished to the great satisfaction of the entire profession.

Of the many improvements that have been made in the carbon process within the past twenty years, there are none that have been more appreciated, and that are of greater benefit to the professional carbon worker, than our new rapid method of sensitizing carbon tissue, is to the carbon printer and advanced amateur of today.

It reduces this operation to the most simple form, and does away with the mussy and unpleasant method of soaking the tissue in a bath of bichromate until it becomes saturated, and then requires from 4 to 12 hours drying before it can be used; which sometimes is almost an impossibility, in a hot, moist atmosphere, unless the proper apparatus and arrangements for rapid drying are at hand. With this new method, the tissue can be made sensitive and dry, ready for

use in five minutes, or in about the same time it takes to put the tissue through the bichromate sensitizing bath, after the old method.

The work is simple, clean and expedient, and in the matter of economy, nothing better could be devised.

Carefully prepare the sensitizing solution after the following formula:

Marton's Chromic Sensitizer	1 ounce
Water (distilled or boiled rain water, hot)	8 ounces
Alcohol or Columbian Spirit	8 ounces
Sulp. Ether	1 ounce
Ammonia (880)	½ ounce

Dissolve the chromic salts in the hot water and when cool, gradually add the ammonia and shake well; then add the mixture of alcohol and ether a little at a time, and again shake. Allow the precipitate to settle, and filter through cotton. Cover the funnel to keep the spirit from evaporating. This sensitizer must be kept in a well-stoppered bottle and stored in a dark place when not in use.

To Sensitize.—Place the tissue, film side up, on a clean surface, and apply the solution with a good soft brush or silken sponge. Pass the brush over the film, both ways, to distribute the solution as uniformly over its surface as possible. If a drying box is at hand, the tissue will be dry and ready for use in five minutes, and will yield prints in every way equal to those printed on tissue that had been saturated with bichromate, and took hours to dry. The chromic sensitizer penetrates only into the immediate surface of the film, consequently there is but very little chromium salts brought into actual use by this process.

So long as the immediate surface of the tissue is only affected by the sensitizer, the chromic salts may very easily be removed and the tissue rendered entirely insensitive to

light. Take two prints and pin them, back to back, and let them soak in several changes of clean, cold water for about fifteen or twenty minutes, then immerse in a 5 per cent solution of anti-chrome for five or ten minutes and after again rinsing, hang them up to dry.

Exposed tissue treated in this manner will be entirely insensitive to light, and may be developed at any future time. Development is affected in the usual way with the exception that there need be no precautions taken in regard to protecting the tissue against light.

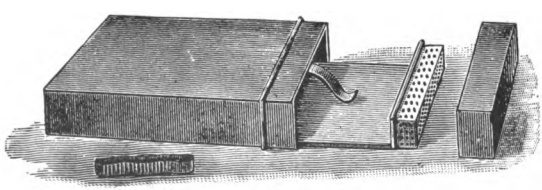
CHAPTER XII.

CARE OF THE SENSITIVE TISSUE.

AS I have previously stated pigment tissue in a wet state is not very seriously affected by ordinary diffused light; but, when once dry, it is from three to six times as sensitive as albumen or aristo paper, and must, therefore, be well protected against the injurious effects of white or actinic light.

Nothing definite can be said regarding the keeping qualities of a sensitive tissue. It is something that greatly depends upon local conditions and manner of treatment. Sometimes, especially in the hot days of summer, tissue that has been sensitized one day, will be quite insoluble the next; and then again, it will keep in good, soluble condition for several weeks, and sometimes for months, in winter if properly taken care of.

Usually, a good carbon tissue, if properly sensitized and dried under favorable conditions, will, if stored in air-tight tin boxes or tubes, keep in good working order for two or three weeks in winter, and from four to six, and sometimes ten days in the summer.



PRESERVING BOX FOR SENSITIVE TISSUE.

Carbon paper, intended to be stored for a considerable length of time, must be thoroughly desiccated in a pure atmosphere, and then put face downward upon a clean piece of soft paper and rolled up film outward. The paper covering the face of the tissue will prevent the hands from coming in contact with the sensitive film, and will otherwise protect it from injury. Paper rolled with the film outward is much easier handled during printing operations than when rolled the opposite way.

The tin receptacle in which to store the roll of sensitive tissue should have a fairly good diameter and be long enough to allow a small quantity of chloride of calcium wrapped in tissue paper, to be stored at the top (for the purpose of keeping the tube free from moisture.)

The roll of sensitive tissue must be well wrapped in paper to keep out all dust that might arise from the lime or calcium. A band of rubber tape placed around the rim of the cap or cover like on platinotype tubes will make the receptacle perfectly air tight.

Tissue having the sensitizing agent incorporated during the process of manufacture, has much better keeping qualities than plain tissue made sensitive in a bichromate bath.

FLAT PAPER HOLDER.

A great deal also depends upon the ingredients and quality of the material employed in the manufacture of the tissue, especially the gelatine. A pigment paper prepared with ordi-

nary gelatine is soluble at a much lower temperature and has much better keeping qualities than tissue made of the finer grades, but the latter yields the finest pictures.

REMARKS.

When carbon tissue in rolls has not been properly stored it will become dry and horny, and will be so brittle that it will be found quite difficult to handle without breaking or injuring the film.

The only remedy for tissue in this condition, is to expose it to moisture until it becomes perfectly pliable. It can then be immersed into the sensitizing bath without difficulty or may be rolled face out and stored in tin receptacles, in which it will retain sufficient moisture to keep it pliable for future use.

If the end of a roll of carbon tissue that has become dry and brittle be fastened in between two slats of wood and hung up in a damp place with the roll hanging down, the film will absorb the moisture and as it becomes pliable, it will gradually unroll itself by its own weight without creasing or breaking, and may be handled with very little difficulty.

The only way to keep tissue in a good pliable state is to store it in tin receptacles. Another splendid way to keep the tissue in a good manageable condition, is to take the roll when fresh and pliable, and roll it film side out around an inch roller.

The film must, of course, be covered with a soft paper to prevent finger marks and other injurious contact. In this way the tissue is easily managed, and if it becomes dry or brittle there will be no danger of cracking or breaking the film.

Squeegee plates that are used for the purpose of drying

sensitive tissue upon, must be well washed in hot water before applying the French chalk or ox gall.

The plates must be perfectly dry and the chalk well rubbed in over the entire surface. Dust off well with a camel's hair duster, and then rub with a clean flannel until apparently all traces of chalk have disappeared.

It is well to bear in mind that a bichromate solution of high strength will render the tissue extremely sensitive, and that the keeping qualities of very sensitive tissue are not as good as that of tissue sensitized on a bath of medium strength. For this reason it should be thoroughly desiccated in a pure atmosphere in summer, and stored away in air-tight tin receptacles in a dry, cool place. Never omit the lime or calcium at the top of the tube.

A highly sensitive tissue has a tendency to produce softness and produces flat, sunken-in appearing pictures, unless the negatives are sufficiently strong in contrast. It will reticulate and become very easily insoluble in warm weather.

A carbon tissue that dries out quickly, has better keeping qualities than that which has occupied a longer time in drying, but is not nearly so sensitive. It is very readily soluble and the development is quickly done. These qualities more than compensate for the slowness in speed.

Bichromate of sodium is the least expensive and makes a good bath for summer use, but the tissue will absorb moisture more readily than if it had been sensitized on any other kind of a bath, and is therefore best suited for a dry atmosphere.

In hot weather a few drops of a ten per cent solution of bichloride of mercury will prevent reticulation.

Never forget to remove the dust from the face and back of the tissue just before immersing it into the bichromate solution. And if there are any signs of mold or mildew it

must be removed with a soft chamois or tuft of filtering cotton, and then well dusted.

EFFECTS OF TEMPERATURE AND CLIMATIC CONDITIONS ON SENSITIVE CARBON TISSUE.

Carbon printers in the different parts of the country, all have their trouble to contend with; which arises from various causes, and are peculiar to the climatic conditions of the country which they live in.

Thus, the high temperature of Southern climes causes excessive dryness of the tissue, and in localities where there is excessive moisture it hastens insolubility.

The excessive cold in winter in the north also brings its trouble, but being dry it is much easier to overcome than excessive heat and moisture.

The humidity of atmosphere in countries bordering on the Atlantic and Pacific oceans, has its peculiar effects upon the tissue, especially in the southern portions where excessive heat and moisture prevails at all seasons of the year. And likewise the excessively light and dry air and the bad water of mountain and alkali countries, brings on its peculiar trouble.

All these difficulties may easily be overcome by closely observing the rules regarding temperature and atmospheric conditions and paying strict attention to the directions given for the sensitizing and drying of the tissue, and the purity of the water used for transferring and development.

Part II.

CHAPTER I.

THE NEGATIVE.

IN THE carbon, like in every other photographic printing process, the quality and fineness of the resulting pictures greatly depends upon the character and printing qualities of the negatives employed.

Therefore, all negatives that are made expressly for carbon printing should be made as nearly in accordance with the requirements of the process as possible, to obtain the best results that can be produced by this process.

Although it is quite possible to obtain beautiful pictures from thin or medium grade negatives, yet to insure the most perfect results, it is best to employ negatives of good density and fine gradation.

The qualities essential for the making of good carbon pictures are:

1. Brilliant, and yet soft and harmonious lighting.

2. Transparent and well illuminated shadows with plenty of detail; brought out by a liberal exposure and careful development.

3. A clean, clear development that gives pureness and richness of tone, and the necessary snap so desirable for the production of fine and brilliant carbon pictures.

Avoid as much as possible, inappropriate backgrounds and accessories. The former should be in harmony with the

subject and accessories, either light or dark as the case may be; and the latter should be suited to the tone and style of the back ground, as well as color and style of drapery worn by the subject. A light ground requires delicate, dainty accessories, and a dark background, massive and carved antique. Heavy, rich draperies and fine rugs with mounted heads, and the judicious use of fine vases, flowers and statuary, produce very elegant effects.

It is not within the scope of this work to give a detailed description of the various methods now in vogue to produce negatives that are possessed of qualities prescribed for the production of artistic effects in carbon printing. I will, therefore, only give a few passing remarks upon this subject.

There are numerous very clever workmen among the great army of photographers in this country, whose artistic ability and superior workmanship places them far above the average professional. Some of them have followed the paths of the great masters in painting and photography, and from them have adopted or chosen a style peculiar to their ideas of art in photography.

To the latter the carbon process certainly must be a revelation, for it is a process capable of gratifying the most extravagant wishes or ideas entertained by the most fastidious photographer.

The prevailing styles in which carbon pictures are now finished are rich and elegant. The carbon porcelains especially, are becoming very popular.

Pictures from ordinary negatives, if made by the single transfer process, will be reversed; therefore, if it is desired to have them in their true positions, either the double transfer process must be resorted to or the negatives must be previously reversed in order to bring the image into its proper position.

The work necessary to reverse a negative film for single transfer printing, is very simple, and may be accomplished by resorting to any of the well known methods now in use. Probably the most simple of all is to reverse the image in the camera, by simply turning the plate with the glass side towards the lens. Select a plate that is free from scratches or blemishes of any kind, and one that has as little curve to it as possible. Clean the glass well and place a piece of red or black velvet or paper to the film side to prevent injury from the spring.

If the plate is a thin one the focus need not be adjusted; should it be a thick one, however, move the holder forward enough to allow for the thickness of the glass.

This method gives good results and causes but little extra work or trouble.

Transparent celluloid films are well adapted for carbon printing. On account of the thinness of the film, they may be printed from either side without a perceptible difference in the sharpness of the image.

The safest and best way, however, is to use stripping plates. These may be had in almost any brand, Orthochromatic and Nonehalation, just as desired, and as a usual thing, they are plates of fine quality and give excellent results.

A good way to proceed is to retouch the negative before stripping then flow with a rather tough collodion or varnish, and when dry flow again with a thick solution of chromated gelatine:

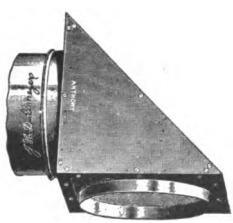
Gelatine	1 ounce
Water	8 ounces
Chrome alum	20 grains
Alcohol	1 ounce
Glycerine	1 dram

Allow the gelatine to absorb all the water it will in about an hour, and then dissolve by gentle heat in a water bath. Dissolve the alum in hot water and add a little at a time while continually stirring the solution. Then add an ounce of common alcohol in the same manner, and coat the plate resting on a level stand. The solution must be warm enough to flow evenly when poured upon the negative. This is best done by pouring a sufficient quantity upon the center of the plate and guiding it to the sides with a feather. When the gelatine has set, stand the plate on end to dry.

When dry, cut the film through to the glass about an eighth of an inch from the edge, and strip it from the glass.

You will now have a tough film that will not curl and may be printed from either side, just as desired, by placing it against a clear glass. If necessary, more improvements may be made on the other side of the film with brush and pencil.

To one who has never used stripping plates it may seem a very difficult proceeding, but such is not the case; after a trial or two, it will be found quite easy.



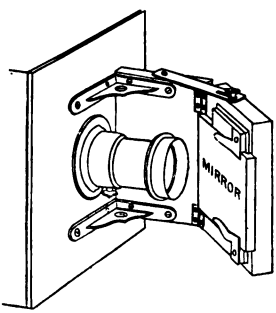
PRISM.

The latest invention in stripping films is a heavy paper coated with a negative emulsion. It is exposed the same as a plate and developed like bromide paper, hardened and mounted on a clear glass that has previously been coated with a chromated gelatine. When the film has become perfectly dry, the paper support is stripped, and the negative film remains firmly attached to the glass and may now be retouched and treated just like any other negative. The work is simple, safe and easy, and promises to do wonders for the advancement of the carbon process.

Pictures made from ordinary or non-reversed negatives are brought into their proper position by resorting to the double transfer process.

For those doing an extensive business in carbon printing, prisms or reversing mirrors are the proper things.

PRISMS.



REVERSING MIRROR.

Prisms that are accurately made so that the three surfaces work perfectly in harmony with each other; and of glass free from all optical imperfections; are quite as expensive as high class lenses. Unless a prism is perfect in every way, it will be found impossible to get absolutely sharp pictures with it.

REVERSING MIRRORS.

Reversing mirrors, employed to correct the negative for single transfer printing, differ from the ordinary mirror, in that the glass is silvered on the surface exposed; which must be optically plane. The work requires as much skill on the part of the optician as the making of a high grade lens.

The mounting must be done in a well seasoned wood frame, loose enough to be free from pressure in every way. Even a slight pressure will curve the glass, though it be quite thick, which will cause distortion and make the image quite imperfect.

CHAPTER II.

STRIPPING AND REVERSING NEGATIVES MADE ON ORDINARY DRY PLATES.

TO REVERSE the film of an ordinary dry plate the following mode of procedure will be found simple and reliable:

Dissolve 1 ounce sulphite of soda and 2 ounces of alum in 15 ounces of rain water; filter, and immerse the negative in this solution for twenty minutes; wash, dry, and coat the plate with a tough collodion to keep the film from expanding.

Plain collodion (2 p. c.)	10 ounces
Castor oil	1 dram

As soon as the collodion has set (not dry) immerse the plate in the following solution contained in a rubber tray:

Alcohol	5 ounces
Water (soft)	5 ounces
Hydrofluoric acid	1 dram

Rock the tray gently and avoid getting the fingers into the solution if possible. Hydrofluoric acid, when carelessly handled, is rather dangerous.

After a few minutes the edges of the film will begin to rise; it may then be stripped from the glass and washed for a few minutes in equal parts of alcohol and water to which a few drops of ammonia have been added. A clear glass, previously coated with a partly insoluble gelatine and dried, is then slipped under the reversed film and gradually lifted out of the water.

Lay the plate holding the film down flat on the table and cover it with a rubber cloth, then apply the squeegee very carefully and bring the film and glass into intimate contact, which completes the operation.

Hydrofluoric acid destroys the enamel on glass and therefore must be kept in rubber receptacles.

The following is another good method: After development, the negative is fixed and washed in the usual way. Then place it for five minutes into a solution composed of:

Water	10 ounces
Formalin	1 ounce
Glycerine	2 drams

Dry without washing. If the plates to be stripped have been dried and are probably old plates that have been retouched, remove the retouching varnish with alcohol, and let them soak in clean, cold water for at least a half hour, then immerse for about ten minutes in the formalin and let dry as before. When dry coat with a collodion made after the following formula:

Amyl Acetate	1 ounce
Columbian spirit	2 ounces
Ether	1 ounce
Gun cotton	48 grains

Let dry for a day and then cut around the edge with a sharp knife, and strip the film from the glass.

To keep the film from curling, coat again on the opposite side.

My favorite method is the following: Take a negative that has been dried and allow it to become well water-soaked and then immerse it into a 10 per cent solution of formalin to which add a few drops of glycerine, and let it dry without washing.

When perfectly dry, cut the film through to the glass

about one-eighth of an inch from the edge, and flow it with a 2 per cent collodion, which is allowed to set, and is then rinsed under the top until the water flows smoothly over its surface.

The plate is then immersed in:

Water	10 ounces
Hydrofluoric acid	1 dram

The most expedient way, however, is to cut the film through to the glass, and, without previously soaking, put it into the formalin solution for 5 to 10 minutes; then rinse until the water flows smoothly over the surface. Then immerse into the Hydrofluoric acid solution as above.

Rock the tray gently, and when the film begins to pucker up around the edge, lift the plate from the solution and press a moist piece of blotting paper, a trifle large than the negative against the film. Now lift up one corner of the paper, and the negative film will adhere thereto as it is pulled away from the glass. The negative film now resting on the blotter is then carefully rinsed under the tap. Now moisten a piece of good, firm writing paper and press it against the film resting on the blotting paper, then turn it over and carefully remove the spongy blotter and again rinse the film under the tap, to remove all traces of acid. A glass plate, which has previously been coated with an insoluble substratum, is now immersed in clean, cold water to soften the gelatine; then place the negative film resting on the paper in contact therewith, and carefully pass the squeegee over the back of the paper, to bring it in perfect contact with the glass; now raise one corner of the paper and carefully remove it, leaving the negative film firmly attached to the glass, which then completes the operation.

If the film is transferred to a very thin transparent celluloid it may be printed from on either side. Double coating it with collodion does almost as well.

FLUORIDE OF SODIUM.

Instead of hydrofluoric acid, fluoride of sodium may be used. Its action is somewhat slower, but the final results are the same and has the advantage of being handled without danger. This may be kept in glass bottles and in a dry state.

The following is a good proportion for the average plate:

Fluoride of sodium .....2 drams
Soft water .....15 ounces

Under ordinary conditions the film will begin to rise in five or six minutes. If pyrogallic acid had been used for development, a little addition of fluoride will hasten the action.

If desirable, the negative film may be enlarged considerably by adding 20 grains of citric acid to the above solution and omitting the collodion. Place the detached film in cold water until the desired enlargement has been affected, and then mount on a clean glass plate as previously directed.

HYDROCHLORIC ACID.

Stripping with hydrochloric acid is a favorite method with a good many process workers. Nearly every one is familiar with the use of this acid in their every day practice. It is considerably less dangerous than hydrofluoric acid and is easily obtainable. Will keep in glass bottles, and is not nearly so expensive.

Prepare the negative as previously directed, unless it is desired to enlarge the film, and proceed in the following manner:

Into a clean porcelain tray pour 10 ounces of distilled water, and add 1 ounce of the acid. Immerse the negative and rock the tray gently for a few minutes, then rub the edges slightly to start the film to rise. When the film has become entirely detached, rinse it in clean water and after turning it over transfer it to a clean glass plate as previously directed.

REVERSING AND TRANSFERRING THE IMAGE TO ANOTHER PLATE BY CONTACT.

Another very simple manner of reversing the image is by excessive over-exposure. This is an old method but has never been extensively practiced. The main reason is because it takes just a little experimenting to find out the exact length of time to make a correct exposure on negatives of different densities and color. Usually the first trial is deficient in exposure or the plate is not fully developed.

To be successful proceed as follows: Select a plate of medium speed and as flat as possible, and expose it under the negative to direct sunlight, or diffused light, in the open air. The length of exposure varies from three to thirty seconds, owing to the density of the negative and strength of the light. For a medium negative ten seconds will be sufficient.

If the resulting negative is flat, foggy, and wanting in vigor, it is under-exposed, and the remedy is more time. If it comes up hard and harsh, it is overtimed and less time is the proper remedy.

When once familiar with this method it may be turned to profitable advantage, and oftentimes the original negative can be improved upon.

Artificial light may be employed instead of daylight if more convenient.

The exposure varies according to the intensity of the light. For instance, for an ordinary gas flame at fifteen inches distance, minutes, instead of seconds that would be proper time by daylight, will be found about correct. A Welsbach incandescent gas burner is about equal to one-fourth the intensity of diffused daylight.

When taking a negative from the dark room to the light, it should be well protected, and exposed as carefully as though it had been done in the camera.

The light must come direct and no oblique rays allowed to creep under the edges.

After the exposure has been made, again protect the plate while taking it to the dark room for development, which is done in the usual way.

When the exposed plate is examined by the light of the dark-room, a faint positive image will be visible, which remains on the plate even after development, but can be removed.

The development is best done with old developer or one that contains considerable restrainer. When the plate is immersed into the developing solution it will immediately flash up and turn black all over the surface like a plate which has been fogged. This makes it impossible to judge the progress of the development by the appearance of the plate, and consequently must be done by time. The best way to proceed, is to immerse the plate as long as it takes to develop a normally exposed negative, and then add two minutes to make sure that it has not been under-developed.

Fix the negative in the usual way and rinse in clean water, then immerse in a weak solution of cyanide of potash, to which a few drops of tincture of iodine have been added, to remove the positive which appears as a slight veil on the shadows previously spoken of. This will clear it nicely; but must be handled with care—cyanide of potash is poison.

Wherever this method is successfully employed, it will be found to have one advantage over those previously described—the original negative remains unaltered and may be used for the production of positive prints by any other process for which the reversal of the image is not required.

The newest method of obtaining a negative from a negative and a positive from a positive, exactly like the original,

excepting that they be reversed, is the acid permanganate of potash process.

A good plate is amply exposed back of a negative, and developed with a developer capable of carrying the image to its full depth, which is strictly necessary in this case. The plate should be left in the solution until the image appears plainly on the back; it sometimes gets a little foggy, which will do no harm whatever.

After the plate has been fully developed, rinse it well in clean water and then immerse it into acid permanganate solution, composed as follows:

Permanganate of potash	2 grams
Sulphuric acid	20 c. c.
Water	1000 c. c.

This bath acts very quickly and when all of the black image has disappeared it may be taken out of the solution. The negative image thus formed is composed of non-reduced silver bromide.

The following operations may take place in a good, strong light:

The brown color caused by the formation of manganese binoxide from the permanganate must first be cleared away by immersion in a one per cent solution of oxalic acid.

Then wash the plate well to get rid of the oxalic acid and redevelop with a good metol developer.

Metol	10 grams
Sulphite of soda	40 grams
Caustic soda	5 grams
Water	1000 c. c.

The development, which takes place very rapidly is best done in a good, strong light.

When the image has gained the proper strength rinse and stand on a rack to dry.

Fixing in hypo is not necessary after the second development.

The quality of the resulting negative depends entirely upon the first development; which should be carried just as far as possible, fog or no fog.

If the image is found too vigorous, it may again be reduced in a solution of permanganate, and treated as before, to a bath of a one per cent solution of oxalic acid, and well rinsed.

Should there be a tendency to softening or frilling in the permanganate bath, add a little alum, which will invariably correct that fault.

Another way to make a negative from a negative:

Make the following two solutions:

No. 1.

Water	1000 parts
Sulphite of soda	50 parts
Hydrochinone	20 parts
Caustic soda	20 parts

No. 2.

Water	100 parts
Bichromate of potassium	2 parts
Nitric acid	1 part

Expose a dry plate under the negative and develop it until it can distinctly be seen from the back. Stop the development by plunging it into a solution of a 3 per cent solution of boracic acid, and wash. After that immerse in open daylight into Solution No. 2.

After the black image has been transformed into a yellowish-red one, wash it well, and place it into a dish containing 5 per cent solution of caustic soda. The picture will disappear, and after washing it is redeveloped in Solution No. 1. The result will be a negative rich in detail, which is to be fixed and washed as usual.

CHAPTER III.

THE MAKE-READY, OR PREPARING THE NEGATIVE FOR PRINTING.

SUPPOSING the operator has exhausted all his skill and artistic ability in producing a high-grade negative as far as lighting, pose, and composition is concerned; but has failed in his chemical or developing manipulations, to produce a negative that has the right qualities required for carbon printing.

In such a case, the first step will be to find some means by which to improve or supply the deficient qualities not obtained in the development.

No matter how excellent or perfect a negative may seem to be, it will always admit of some improvements being made on one part or another, by suitable methods.

It is a well known fact among those familiar with the carbon process that a great many failures to obtain satisfactory results from apparently good negatives, are due to carelessness in the make ready, or preliminary preparations made by the printer upon the negative previous to exposing the tissue to light.

It is therefore, well to bear in mind that all the time and labor skillfully and judiciously applied in improving the printing qualities of a negative, will be amply rewarded with beautiful and harmonious effects.

Elegant draperies, fine laces, and also the backgrounds can be wonderfully improved by the master hand of a skillful printer.

Landscape negatives may be redeemed from flatness or too much contrast in like manner.

Every good printer has a few dodges or tricks of his own invention by which to improve his negatives, and, for him, will probably be the best to employ. I will, therefore, only mention a few of the most practical methods in use.

The best and most approved method for all purposes is a coat of matt varnish on the glass side of the negative:

Sandarac	100 grains
Mastic	25 grains
Ether	3 oz.
Benzole	1¼ oz.

If considerable contrast is desired, an addition of a few grains of iodine will give a tint that will answer this purpose admirably. For too much contrast, scrape off the high lights; also where there is white drapery. For flatness, cover the high lights and scrape off the shadows. If scraping is found too troublesome, a transparent varnish such as mastic may be applied with a camel's hair pencil, which will answer just as well.

Very effective work in the way of retouching may be done on the matt varnish with graphite and stump; and any amount of detail may be worked over and improved by this method.

Another and similar method to the above is practiced extensively in Germany.

Make and apply the following solution to the glass side of the negative as you do varnish:

Water	3 ounces
Gelatine	3 drams
Sugar	1 dram
Alcohol	5 drams
Aurine	24 grains

When sufficiently dry, scrape off whatever parts found

necessary, and apply a clean matt varnish. If found necessary again scrape off varnish, and print under tissue.

These methods, if practically applied, will make wonderful improvements in the printing qualities of defective negatives.

Carbon printers of the old school, and especially the English and French, employ a very fine tissue paper called mineral paper, with which they cover the glass side of the negative; and when there is considerable work to do they cover the face with a very fine grade of the same material.

This paper, when cemented around the edges, lies smoothly and firmly to the surface of the negative, and admits of very fine work being done with stump and pencil.

For soft and mellow effects from a harsh contrasty negative, I know of no better method than the employment of a light positive from such a negative. It must be placed exactly over the negative and printed in subdued light. Probably an easier and cheaper way is to make a print on some old aristo platino paper and fix without toning. Then mount it face down on a clear glass with

Gelatine .....1 ounce
Water .....5 ounces

Soak the gelatine in the water and dissolve by gentle heat; then add slowly, about ten grains of chrome alum previously dissolved in a little hot water. When dry, apply hot water with a sponge to the back of the print; that will loosen the paper and allow it to be stripped off of the film, leaving a nice, clean positive.

If found too troublesome to mount the print on glass and to remove the paper, a print made clear with and mounted onto the face of the negative, will answer nearly as well, but, of course, prints much slower. This is a splendid method to improve large negatives.

For local application, and to obtain slight increase of contrast, Prussian blue (water color) will be found excellent. For considerable contrast, raw sienna, yellow lake, or chrome yellow are best.

To block out parts of a negative apply Venetian red or Chrome yellow to the glass side of the negative.

THE SAFE EDGE.

The purpose of the safe edge is mainly to have an easily soluable edge around the carbon picture, that will prevent puckering or washing up of the film and will give nice, clean cut margins, and will be a safeguard against injury to the pictures when removing the paper from the back of the film, at the beginning of the development.

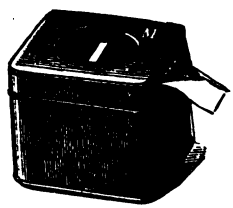
A strip of red, yellow, or green paper at least one-eighth of an inch in width; or a mask of any shape or size the negative will admit, without interfering with the parts to be printed from, is placed on the negative.

For clean cut margins, such as are required for pictures developed on celluloid, porcelain, or etching paper, it is best to put the mask on the film side of the negative; otherwise it had better be on the glass side. That will give a softly blended edge and the film will not frill, no matter how heavy the deposit. On large negatives, an edge of black varnish, instead of a paper mask, is the easiest to apply. Some operators use a semi-opaque paper, which gives a partly printed edge and causes better adhesion of the tissue to the support around the margin.

CHAPTER IV.

THE PHOTOMETER.

THE exposure to light does not leave any visible imprint upon carbon tissue. Therefore it is necessary to devise some means by which to ascertain the proper length of time necessary to obtain prints of certain strength, and to make any required number of pictures having the same density.



ACTINOMETER.

There are several very simple methods in use, that will answer for a small amount of printing. The most simple is to select another negative of about the same density as the one to be printed from, and expose both for the same length of time, side by side, using aristo paper. Allow the paper, on the negative from which it is intended to make the carbon pictures, to become about what would be called a light proof. The print taken from the negative used as an exposure meter is placed in a subdued light and is used to compare the following prints by.

The manner of proceeding now is very simple. Every time a fresh piece of tissue is placed upon the negative another strip of aristo paper is placed upon the other and both exposed simultaneously, side by side. Whenever the aristo print reaches the same shade of the proof first printed take in the carbon negative and refill it with new tissue, and the other frame with fresh aristo. In this manner any number

of impressions may be made and all be perfectly uniform in density. There are a number of good and reliable photometers in use, of which Johnson's is about the best for ordinary studio work.

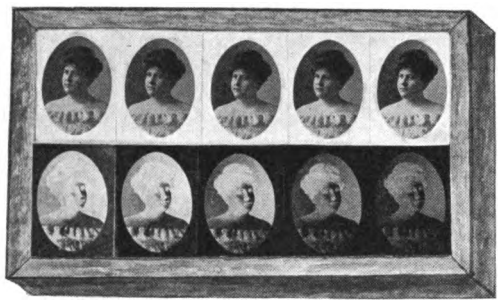
A small tin box with hinged cover, having a glass fastened into it, is so arranged that when a strip of aristo paper is placed underneath the glass it can be drawn out at the side as soon as the paper under the clear glass assumes the shade of the tint painted on the glass.

This operation registers one tint and is repeated as many times as it is required by the negative printing the carbon tissue, to give a certain density.

When reading the instructions how to construct and use an actinometer, it almost seems as though it would be difficult and troublesome to put such an instrument to practical use; but that is not the case. Upon slight acquaintance it will be found very simple and more convenient than printing platinum or aristo paper. All there is to do, is to watch the photometer, and when the paper discolors to match the number of tints marked on the frames, turn them down or lay them in until all are finished, which will only take a few minutes; then refill the frames and repeat.

MARTON'S PHOTOMETER.

A very simple and easily constructed photometer may be made as follows: Upon a small, dry plate make a series of five or six tiny negatives lengthwise across the plate. Number every negative by marking the figures upon each one with opaque. Then take off a print, which when toned, will be of a rather light shade—tone it on the red order, so the color compares well with a newly printed picture. These are nicely trimmed and the strip pasted on the inside of the



MARTON'S ACTINOMETER.

back of the printing frame and used as a standard tint. The plate is then covered on the glass side with one layer of tissue paper, stretched smoothly over the whole by cementing it at the edges. Another strip is then pasted over all except No. 1 and then another strip over all excepting Nos. 1 and 2, and so on, leaving one of the series out at each application of a layer of tissue.

This photometer is placed into an ordinary printing frame and can be used to print a whole series of negatives as easily as one. A strip of aristo paper is used for printing; a roll is not required. The printed strip of paper is replaced by a new one at each change of tissue.

To find the photometer test-number of a negative, expose a piece of aristo paper under the negative simultaneously with a strip of the same on the photometer. Print to a shade about a third or a fourth the density of a finished picture taken from the same negative, according to the rapidity of the tissue to be used, and the time that will probably elapse before development; then compare the printed strip on the photometer with the test pictures, or standard tint. The number of the print that comes nearest the shade or density of the test picture, is the photometer number of the negative, and should be marked upon the frame.

When printing a number of negatives of different densities, all that is required of the printer is to watch the photometer. As soon as a little picture upon the strip of aristo paper bearing the number of a negative appears to have the same shade or density as the test picture above it, take in or turn down all the frames bearing that number, and so on, until the board is cleared.

Always handle the photometer as quickly as possible when there are other negatives depending upon its test.

CHAPTER V.

PRINTING OPERATIONS—FINDING THE SPEED OF A NEGATIVE.

USUALLY, the time required to print a light proof upon aristo paper, or the time it takes to print a picture about one-fourth the density required for aristo prints, will be about the right time of exposure for carbon pictures printed from the same negative under like conditions.

Supposing the development to take place within a reasonable length of time. The *modus operandi,* then, how to find the proper speed of a negative, is to make a light print as stated above and at the same time expose a strip of the same paper in the photometer for exactly the same length of time. Mark the number of the tints and match all the following prints to this one.

Owing to the various stages of sensitiveness the tissue undergoes, the most reliable and safest plan, especially for beginners, is to expose a small piece of tissue by the photometer test, and another just a little longer. Then immerse the two pieces in cold water for a minute and bring in contact with single transfer paper and develop. This will require but a few minutes and will tell exactly how to expose the tissue properly, and will save considerable time and trouble as well as loss of material.

EXPOSING THE NEGATIVE TO LIGHT.

When the negative has been properly made-ready after the foregoing directions and the safe edge applied, one of the most important operations of the whole process is next

in order—exposing the sensitive tissue to light under the negative.

Before beginning the printing operations the pressure frames must be looked over and supplied with good, dry pads, made of felt and thin cardboard, and, as a prefect protection against moisture, a layer of rubber cloth may be added.

This will insure a good, even contact all over the negative and should never be neglected if perfectly sharp pictures are desired.

The springs ought to be good and stout to give the pressure necessary to insure perfect contact.

The frames must be perfectly dry and free from dust; also brush off the negative well before placing it into the frame.

When all is ready take a piece of carbon tissue from the pressure box and remove the dust from the face and place it carefully upon the negative. Use a subdued or yellow light for this operation, and bear in mind that the tissue must overlap the safe edge at least one-eighth of an inch; if this is neglected there is apt to be trouble when it comes to the developing operations.

A good way to equalize the speed of a number of negatives of different densities, is to cover the weak ones with so many layers of tissue paper as will retard their speed to about the same degree of the denser ones. When this is done, the difficulty of printing negatives of different densities is greatly reduced.

A printer of limited experience will find it the safest and best plan to do his printing in the shade, especially in hot weather, unless the negatives are very dense, and require a very strong light.

Never print with the frames exposed to the direct rays

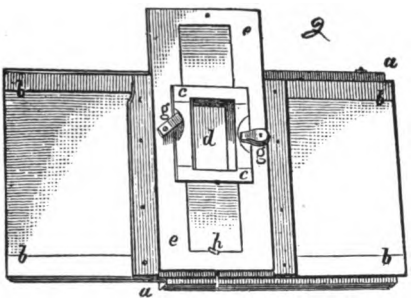
of the sun in summer, unless the time of exposure is very short and the quality of the negative such as to require that manner of treatment. The best prints are made in sunlight at a medium temperature. Arrange a printing board that can be covered with either ground glass or with one or more layers of tissue paper.

Leave the sides open to allow the air to pass freely, in summer. Should the board get hot in spite of this precaution, introduce a screw eye under each corner of the frame; that will allow the air to pass through under the frame and keep it cool.

After the frames have all been filled, place them under the glass, and the photometer in between them. When the proper tint has been reached, cover each negative with an opaque cardboard, or lay it face down upon a convenient table, until all the rest have finished printing; when the light is again subdued and the operation of refilling the frames gone through with; or, if more convenient, change each negative as soon as prints are finished. The actinometer or negative used as an exposure meter is also supplied with fresh aristo paper. Place them out under the glass simultaneously and repeat the operation until the required number of prints have been made. In cold, cloudy weather, prolong the exposure a little, the same as you would for a silver print; and on a bright, warm day, cut it a little shorter. The action is more vigorous in warm weather than when it is cool. For the expert printer, there is a vast amount of latitude in carbon printing; both over and under exposure, if properly managed, may result in good prints nearly always. At this juncture it is well to bear in mind that when carbon tissue has once been exposed to light, the action is continuous, especially so in a warm, damp atmosphere, and that due allowance must be made therefore, espe-

cially when a number of prints are taken from the same negative before development. Should the development be delayed for a considerable length of time this peculiar property will manifest itself in a marked degree, most usually resulting in over exposure. A splendid way of keeping exposed tissue before development, is to store it in perfectly dry tin receptacles, containing dry calcium chloride.

Another and probably the best method is to use an antichrome check bath, which will be fully described further on.



UNIVERSAL PRINTING FRAME.

Since there is no visible imprint by which to distinguish the difference, it sometimes happens that the tissue that has been exposed gets mixed with the unexposed. To avoid this trouble mark "Ex" on the back of each piece of tissue, as well as the number and top of the negative as it is taken from the frame after exposure. In case this precaution is forgotten breathe on the film of the tissue, and if it had been exposed the image will appear faintly, but will immediately disappear. Avoid touching the surface of the tissue with bare fingers as much as possible, especially when damp.

Unless there are one or more assistants it is best to develop the print every hour or two; for, if the printer is not an expert in calculating the speed of the continuing action of light upon the tissue for a given length of time, the first

impression made will be much darker than those made at the end of the day. The best results are obtained by giving full time and developing immediately after exposure, which is the proper way to do where there are one or more assistants, equipped with the necessary apparatus, etc.

THE CARBON VIGNETTE.

These beautiful pictures are the most difficult of all to make.

The delicacy and beauty of carbon vignettes necessitates a very fine gradation in printing, and it seems as though most carbon workers neglect to familiarize themselves with this fact; consequently the majority of them make a failure of this class of work, simply because they are not familiar with the chemical action of light upon bichromated gelatine under certain conditions.

Tissue sensitized in a bath containing 8 per cent of bichromate and 4 per cent of liq. ammonia, to which add 2 per cent of accelorine—has splendid keeping qualities and has a tendency towards softer gradations.

When the tissue is new, it works with vigor and contrast; and when about two or three days old it prints softer and is therefore better suited for vignettes. For double transfer vignettes, prepare the surface of the temporary support with talc, and give it a substratum of bichromated albumen. This is prepared by adding some of the alkalin bath solution to a 10 or 15 per cent solution of albumen. When two or three days old filter, and it will flow as even and smoothly as collodion. When dry expose the plates to light to harden the surface, and they are ready for use. Before transferring the tissue allow them to soak for a few minutes in clean water.

CHAPTER VI.

THE CONTINUOUS ACTION OF LIGHT.

PROBABLY one of the most perplexing difficulties the carbon printer has to contend with is the curious phenomena of the continuous action or insolubilization that goes on after the tissue has been exposed to light. This peculiar property of bichromated gelatine sometimes tries the patience of the carbon printer to its fullest extent, in one way, and in another, proves itself a great advantage in saving prints, which, without this continuous printing property, would be a failure and a total loss.

This difficulty, if so it may be called, besets the carbon printer most seriously in warm weather; but if the proper provisions are made, it can very easily be avoided.

Thus, unless the proper precautions have been taken, the tissue that has been exposed in the morning, if left for development until evening, will be found considerably too dark if not totally insoluble.

The hardening action set up by the exposure to light progresses more rapidly in the presence of heat and moisture, than in a cool, dry atmosphere.

This action may be easily observed in warm weather by leaving a piece of exposed carbon tissue to the influence of a warm, damp atmosphere for a given length of time, and another for the same time, in a dry, cool place and developed simultaneously. This experiment will plainly show that the increase in density went on quite rapidly, and would have resulted in total insolubility of the former, had the action not been arrested in time by development.

On the other hand, it will be found that the piece of tissue which had been stored in a cool, dry place, for the same length of time, was very little affected and the increase in density of the latent image was hardly perceptible.

It is therefore advisable to keep the tissue as cool and dry as possible after exposure to the hardening action of light. Or, if the developing rooms are so arranged as to allow the development to be carried on conveniently, it will be found by far the best plan to develop immediately or at least every hour, especially in warm weather.

It will thus be seen that strict attention must be given to the temperature and humidity of the atmosphere, and due allowance be made therefor in measuring the time of exposure, according to the length of time expected to elapse before the development takes place.

The above applies to ordinary studio work only. Where carbon printing is carried on extensively, the printer usually has one or more assistants, and development is carried on simultaneously with the printing, and the difficulties caused by the continuous action of light are avoided.

While this peculiar property of bichromated gelatine will often prove itself an annoyance and sometimes bring disappointment, it will also prove itself a blessing and a great advantage after the conditions pertaining to its application are properly understood.

This will be found especially true when the solar printer takes advantage of this property, in making enlargements, or printing by artificial light.

A fourth of an exposure made in the morning of a warm day, will, providing the tissue has been left to the influence of the atmosphere, through the agency of this continuous action of light, have gained sufficiently in strength, to develop as a fully exposed print in the evening; and if the at-

mosphere is loaded with moisture, a few hours will suffice to gain the same result.

It will thus be seen that the hardening action which began with the exposure of the tissue to light, continued until it had increased the density of the latent image to a degree, that, if it had not been arrested in time, the resulting picture would have been too dark, if not entirely insoluble.

The greatest care should be exercised in drying sensitive carbon tissue, not to expose it to white light; for just as soon as it is dry, no matter how slight it may seem to have been, this continuous action will assert itself in time and cause insolubility or lack of adhesion to the support, a trouble so often attributed to other causes.

This peculiar action of light on bichromated gelatine can easily be arrested if desired, and the exposed tissue developed at any time afterwards to suit the convenience of the operator; in fact it is immaterial when it is developed; if properly stored it will keep indefinitely and will work just as well in ten years as if it had been developed the same day.

The mode of procedure is very simple: Rinse the exposed tissue in clean, cold water until the soluble bichromate is pretty well washed out, then immerse it for twenty minutes in a five per cent solution of antichrome and again rinse in several changes of clean, cold water and hang up to dry.

The exposed tissue, made insensitive to light after the forgoing directions, is transferred and developed in exactly the same manner as when in a sensitive state, with the exception that the precautions to protect it against light, need not here be regarded.

THEORY OF THE LATENT IMAGE AND ITS DEVELOPMENT.

The action of white light has a hardening effect upon bichromated gelatine, according to strength of solution used

and the penetrating power of the actinic rays to which it is exposed. Thus, if a piece of sensitive carbon tissue be exposed to light under a negative, the entire surface of the film will be rendered insoluble, excepting where the negative was so dense as to entirely obstruct the passage of light. Upon this insoluble film of pigmented gelatine is formed the latent image, to a degree, varying in strength and density, according to depth of penetration and actinism or probably better said, power of insolubilization, of the light to which it was exposed, through the varying densities and gradations of the negative; thus forming a picture of insoluble pigmented gelatine with all the delicate detail, strength and vigor capable of being produced by the negative employed.

The strength and brilliancy of the resulting picture also greatly depends upon the state of solubility the tissue is in and the amount of coloring matter contained in the film, as well as the depth of penetration by the actinic rays of light.

The surface of the pigmented gelatine adhering to the paper upon which it is coated, remains entirely soluble, and by bringing the surface of the film into intimate contact with a suitable support that will keep it intact, the paper may readily be separated from the film, by immersing the tissue in hot water, thus exposing the soluble surface of the gelatine to the action of the water, which dissolves the unaffected parts, and with it, washes away all the pigment contained therein, and in that manner, reveals the picture in strength and gradation according to the quality of the negative employed.

Part III.

CHAPTER I.

THE SINGLE TRANSFER PROCESS—PRELIMINARY REMARKS.

THE development of carbon pictures by single transfer is very simple and devoid of all difficult manipulations, and it is well to be thoroughly familiar with and understand this method first, before attempting to master the more difficult double transfer process.

The pictures made by this process from ordinary negatives, are reversed, on account of the tissue being transferred and developed upon another support, usually paper, celluloid, or opal glass.

This transfer is absolutely necessary on account of the image being formed on the surface of the tissue exposed to the action of light, which has consequently become entirely insoluble. Therefore, in order to effect the development of the latent image, it is necessary to transfer the tissue to another support and accomplish the development from the back, where the light has not penetrated and the gelatine remained soluble or unaltered.

Carbon pictures are developed by means of hot water which permeates the paper or original support and makes soluble the unaffected parts of the gelatine, which then allows the paper support to be removed, thus exposing the image to the action of the hot water, which dissolves and washes away all the soluble parts, and with it the pigment or coloring matter it contained, and thus clears the image and affects the development.

PRINCIPLE OF THE SINGLE TRANSFER PROCESS.

If a pigment paper, which has been previously exposed to the action of light under a negative, is allowed to absorb cold water until it begins to flatten out, is brought into intimate contact with a prepared paper, or any plain surface impervious to air or water, such as celluloid, porcelain, china, etc., it will firmly adhere thereto during the process of development, providing the proper conditions pertaining to the sensitizing and drying of the tissue have been strictly adhered to; and it will dry down with a beautiful smooth surface, where it remains in permanent contact with the support.

This is called the single transfer process on account of necessitating but one transfer and the image being developed on its final support.

This process is free from all difficulties and has within recent years been employed almost exclusively by the majority of carbon printers of this country.

In former years it was seriously handicapped on account of the pictures being reversed when printed from ordinary non-reversed negatives, for want of safe and expedient methods of reversing the negative film.

This serious obstacle, which prevented the process from coming into general use long ago, and which always was one of the chief hindrances, to its success has finally been overcome by the use of the modern stripping plate and the many excellent methods of stripping and reversing the films of ordinary dry plates.

The reversal of the negative film, which enables the carbon printer to produce correct pictures by this method, greatly simplifies the carbon process and is a decided step in advance of the older methods employed in by-gone years.

At the same time a great deal of labor and expense is saved, say nothing about the failures, vexation, and disap-

pointment the double transfer method if not very carefully managed, often entails.

The manipulations necessary to accomplish the reversal of an ordinary negative film, are far less difficult and much easier to perform than the operations of the double transfer process.

SINGLE TRANSFER SUPPORTS.

The single transfer paper is supplied by the manufacturer of carbon tissue in rolls of about thirty square feet, and in three different grades—thin, medium, heavy and rough.

Ordinarily, this paper is coated with a substratum of insoluble gelatine, which may be distinguished from the uncoated side, when dry, by its luster. This gloss is not noticeable when wet, therefore as a precaution, mark the back of each piece of paper before immersion.

To make a good single transfer paper take

Gelatine (hard)	1 ounce
Water	16 ounces
Chrome alum	30 grains

Soak the gelatine in the water for an hour and then dissolve by gentle heat. Dissolve the chrome alum in two ounces of water and add it, a little at a time, to the former solution, stirring it well at each addition. Filter, and coat with a camel's hair brush or float the paper on the surface and hang up to dry.

Besides the ordinary single transfer papers, there are several grades of drawing paper; medium and heavy rough matt surface or crayon paper; and the white and toned etching papers, which are used for artistic effects. These are all procurable at the stock dealers but can be easily prepared in the studio, however. Take one ounce of hard gelatine

and soak it in 20 ounces of cold water for an hour; then dissolve it in the usual way, and add while constantly stirring, 40 grains of chrome alum dissolved in a little hot water. Coat the paper with a soft sponge or camel's hair brush, and hang it up to dry.

Let this support soak in clean, cold water for at least ten minutes before making the transfer. Should the paper show signs of softening or become pulpy in the alum bath, remove it and let dry; then again immerse it until all the yellow stain disappears.

The celluloid or opal glass used for single transfer pictures, has a delicate matt surface and works well without a substratum when the tissue is new; but to be perfectly safe, it is best to give it a thin substratum of insoluble gelatine:

Gelatine (hard)	30 grains
Water	32 ounces
Chrome alum	50 grains

Let the gelatine become well water soaked and dissolve it in the usual way; then dissolve the chrome alum in a little hot water and add it to the gelatine; thoroughly mix and filter through cotton.

Flow the solution over the surface, or coat by dipping the celluloid or opal glass into the solution, and hang it up or place on a rack to dry.

Celluloid or opal glass may also be albumenized with a ten per cent solution of albumen; add a few drops of formalin and filter before use. Carbon pictures on celluloid or porcelain are very artistic and probably the most beautiful pictures produced by photographic means. The exquisite delicacy and softness of these pictures, lends them a charm impossible to obtain by any other method.

Carbon porcelains, and especially the sepias are suscept-

ible to a wide range of artistic treatment, both in monochrome and color.

A good quality of Baryta paper makes a very fine support for single transfer pictures. This may be greatly improved by immersing it in the same solution applied to celluloid as a substratum.

Matt surface Baryta paper gives a beautifully soft surface to carbon prints. A good quality of this paper is, however, very difficult to procure.

Cut the required number of supports to the correct sizes, always a little larger than the tissue, and if there are small pictures, a number of them may be mounted upon one piece of support and thus save considerable time in the development.

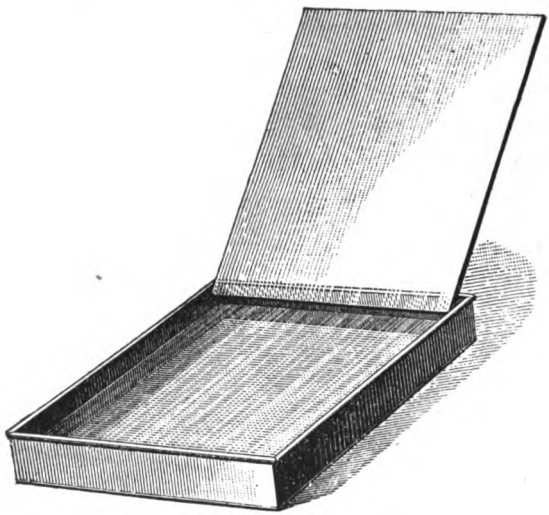
The platino backing papers now on the market, if coated with an insoluble substratum, also make a splendid single transfer paper.

SYSTEMATIC ARRANGEMENT OF TRAYS, TANKS, AND DEVELOPING APPARATUS.

A tank or large tray containing cold water at a temperature not exceeding 60° F., is placed to the left. This tray must be large enough to allow the operator to conveniently manipulate a print and support under water. Next to this, place the mounting tray with the squeegee board—providing a transferring machine is not at hand.

Then comes the hot water tray or developing tank. This must be filled with water at a temperature of about 100° F. and if old tissue has been used 105° or 110° F., will be necessary. A small gas or oil stove must be so arranged underneath the tank as to admit the temperature being raised or lowered at will.

For a description of hot water apparatus see chapter on "Hot water supply."



MOUNTING TRAY WITH SQUEGEE BOARD.

To the right of the developing tank place another tank or tray of cold water not above 60° F. in which the soft gelatine film is allowed to stiffen and is then thoroughly rinsed before placing them into the alum bath.

The alum tank or tray, which must be rubber, porcelain or earthenware, is placed near.

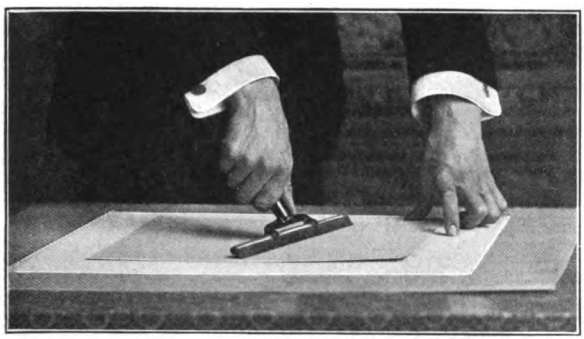
From the alum bath the prints are again transferred to a cold water tray in which they are freed from the alum, which then completes the developing operations.

The size of the trays is immaterial, as long as they are large enough to suit the purpose of the operator. A few weights of convenient size must always be kept at hand. These are easily made of any size by procuring tin boxes from the druggist and filling them with molten lead. When the lids are replaced, they make very neat and handy weights.

The above directions are for development on a small scale.

CHAPTER II.

THE TRANSFER OR MOUNTING THE EXPOSED TISSUE UPON THE SUPPORT FOR DEVELOPMENT.



SQUEEGEE OPERATION.

THE water used for this purpose ought to contain as little foreign matter as possible and should be filtered through muslin. The temperature must not be higher than 68° F. or lower than 58° F. in winter, and must be kept between 50° and 60° F. or lower in summer. Melted ice water is the proper thing in very hot weather.

A few drops of a saturated solution of carbonate of ammonia added to the water will cause a better adhesion. This should be done with great care, however, a little too much might cause trouble. New tissue does not require this addition; it should be used only for tissue which has partly lost its adhesive properties.

The transfer must be made in a subdued or yellow light on account of the tissue being very sensitive to white light.

After it has once become well water-soaked only a very little of the former sensitiveness remains and if all the bichromate is washed out or it has been immersed in a bath of antichrome, it will when dry, be entirely insensitive to light.

When all the preliminary arrangements have been made, immerse the single transfer paper, celluloid, or of whatever nature the support may be, face up into the cold water tray on the left and allow sufficient time to elapse for the water to expel every particle of air in the paper. The heavy rough papers, especially, should be soaked for at least a half hour. If this is not done it may give rise to blisters and numerous little air-bells and cause considerable trouble later on.

To be thorough in this matter, pass a camel's hair brush or silken sponge over the prepared surface of the paper before bringing it in contact with the tissue, to remove all froth or air-bells adhering to its surface.

Now put on rubber gloves to protect the hands and pull down the yellow curtains, or subdue the light. (A yellow light is best.) Then take a piece of exposed tissue and, after removing the dust from both sides with a camel's hair brush, immerse it face down into the same cold water tray with the support.

The water must be at least two inches deep, so that the tissue may be turned over without exposing it to the air in that state.

This is very important, especially during warm weather. If the tissue does not remain completely submerged, at least until it begins to flatten out, there will be danger of reticulation. It should also be borne in mind, that when carbon tissue is immersed in cold water, it will absorb water until

the film is fully expanded, and loses its adhesive properties. Therefore, to cause a good adhesion to the support, it must be brought in contact before it is fully saturated, or when it lies flat and is about to turn backwards.

All the manipulations necessary to affect the transfer must be done quickly and without delay, for the time is limited.

Carefully remove all the air-bells that gather on the face and back—while the gelatine is swelling—with a camel's hair brush. If these are not removed they are apt to cause spots.

If the tissue is allowed to remain in the water considerably longer than is necessary to flatten it out, it will absorb too much water, and will adhere to the support with difficulty or probably will refuse to do so at all.

At the same time it is well to guard against being too hasty. If the tissue is removed from the water and squeegeed to a support too soon, it will keep on swelling, and the water drawn out of the pores of the paper by the gelatine film, is replaced with air, which in consequence gives rise to a froth or the tiny little air-bells when the tissue is developed in warm water. This trouble arises more frequently on a support like celluloid or opal glass, therefore the tissue that is to be transferred to these supports, should be allowed to absorb water enough to be tolerably well saturated, and then let remain under pressure a little longer than a flexible support.

As previously stated, a few drops of liquid ammonia or a little boracic acid added to the water will cause the tissue to adhere better to the support, especially if the tissue is not in good soluble condition. But it must be done with care—too much would cause trouble, especially the ammonia. Some operators use carbonate of soda in preference to ammonia.

Tissue dried upon a collodion film requires the addition of a little hydrochloric acid instead of boric acid or ammonia.

As soon as the tissue touches the water it will begin to curl inward which is caused by the paper swelling or expanding more rapidly than the gelatine film. The curling up is best prevented by keeping the tissue down to the bottom of the tray.

The gelatine film absorbs the cold water and expands gradually until it flattens out, when it immediately begins to curl the other way; this is caused by the gelatine having a greater expansion than the paper. The moment it lies flat is the proper time to bring it in contact with the prepared surface of the support, and must then be immediately removed to the squeegee board or marble slab, and brought into intimate contact. Should it happen that the film becomes fully saturated before it can be brought in contact with the support, transfer and take as much moisture out of the paper with a good heavy blotter, as possible, and then put it under heavy pressure for at least an hour, when it may be developed without any trouble.

Large prints are best brought in contact with the support under water. This is done by either immersing the support first and then the tissue or by slipping the support under the tissue at the proper time, and then lifting the two adhering pieces out of the water and placing them upon the squeegee board. The advantage by this mode of proceeding is the avoidance of air interposing between tissue and support, which is sometimes quite difficult to remove with the squeegee.

When the tissue is taken from the water and placed upon the support, lay the latter down upon a level slab or squeegee board, first; then dash some clean water over it, and as

soon as the tissue flattens out, immediately take it from the water and holding it by the corners diagonally opposite, let down the center first and then drop the corners.

As soon as the wet tissue is placed in proper position upon the support, apply the squeegee; gently, to expel all the air and water, and then cover it with a rubber or thin oil-cloth and apply the squeegee more vigorously, to bring the adhering pieces into absolute contact.

Instead of using a rubber cloth, a thin sheet of transparent celluloid may be used. This allows the tissue and support to be seen, which is an advantage in removing air and moisture. It is also much easier applied and does not ruffle up and cause ridges like the rubber. A scraper made of a thin, firm, but flexible rubber, or a thin, flexible piece of wood may be used in place of a squeegee, when using a sheet of celluloid in place of a rubber cloth. After a thorough application of the squeegee to insure the proper contact, remove the rubber or celluloid and with a clean, soft cloth or sponge, or with a good, heavy blotter, remove all the remaining surface moisture from the back and especially around the edges of the tissue.

If this is not done, it will cause the prints to become patchy and uneven and the edges will sometimes wash up during the development and the pictures be partly ruined.

A soft, heavy blotter and roller squeegee probably does the work speedier than it could be done in any other way; but the trouble with a great many printers, I find, is that they use the blotter too long—it really ought to be used but once and then allowed to dry before it is used again.

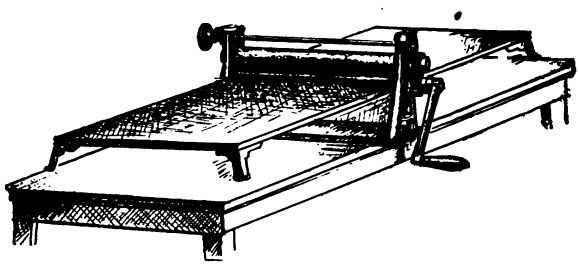
The blotter being wet in patches will absorb the moisture unevenly, and in that way causes a mottled or patchy appearance of the picture; therefore a blotter must only be used once or twice and then allowed to dry.

The adhering pieces of tissue and support are now placed between thin, dry blotters, stacked one over the other and allowed to rest under pressure for from fifteen minutes to an hour, according to the condition of the tissue and the kind of support used. A good sign of sufficiency is when the yellow stain of the bichromate appears on the back of the transfer paper.

A new tissue, in good, soluble condition, requires less time than an old and probably slightly insoluble one. A smooth paper support needs less time than a rough one or such supports as celluloid or porcelain. These should remain under pressure considerably longer, especially in winter.

Prints resting upon transfer paper or other supports awaiting development, must be kept in a moist, cool place, and never be allowed to become dry.

Sometimes it is not convenient to proceed with the development as calculated. If such be the case, remove the



TRANSFERRING MACHINE.

blotters from between the prints and either replace them with a sheet of glass or stack them together and place in a damp, cool place until ready to proceed with the development.

Tissue transferred to celluloid or opal glass will give finer results when left to rest for a half hour or even an hour

in a cool place. Or, if a refrigerator is not at hand, a good and safe plan is to plunge the transferred prints after they have remained under pressure the proper length of time into cold wáter, where they may remain an indefinite time—several hours would do no harm, so the water is kept cool.

The transferring machine (Fig. 21) referred to in a previous chapter, works on the principle of a clotheswringer or burnisher. Two rubber rollers are placed one above the other, and the platform is so arranged as to lead the adhering print and support in between the rollers.

The tissue and support are placed between two sheets of celluloid and are passed through after the manner of burnishing pictures, and if the machine is in good working order, the mounting is rapidly and neatly done. The slight moisture sometimes left around the margin of the tissue must be removed with a dry sponge or cloth.

The employment of a machine affords a great advantage over the ordinary methods for rapidity and cleanliness, and ought to be employed in every well-equipped carbon plant.

TEMPERATURE AND CLIMATIC CONDITIONS.

In the hot days of summer and in southern climes it is best to use a plentiful supply of ice when making the transfer. A nice, cool basement or cellar can not be overestimated, at such times—the lower the temperature the better the results.

Ten minutes will be sufficient time for the transferred tissue to rest before development; a longer time (in hot weather) would be detrimental, unless the tissue be stored in a refrigerator or cool, damp place.

In the development proper, climatic conditions cut no figure, unless it be excessively cold. A newly developed print is very easily ruined, if, when taken from the develop-

ing tank, it is rinsed in water at a very low temperature. Blisters, reticulation, and granularity are sure to follow. Water at about 60° or 70° F. will answer the purpose best.

INSTRUCTIONS FOR USING ROUGH DRAWING AND ETCHING PAPERS AS FINAL SUPPORT IN SINGLE TRANSFER PRINTING.

In the transfer of the printed carbon image from its original paper support to another surface, an essential feature to success, is to secure *intimate contact* between the two.

With smooth surfaces, such as glass, celluloid and many kinds of paper, this is a comparatively simple matter, but the difficulties encountered are greater when dealing with the rough harsh surfaces and unyielding texture of drawing and etching papers, now so much in vogue for their artistic breadth of effect.

A modified treatment becomes necessary, and by following the method now recommended and based on practical experience, the chances of failure are reduced to a minimum.

The transfer paper should be cut slightly larger than the printed tissue to be developed upon it. The cut pieces should be immersed in a dish of cold water for about two or three hours before required for use. Shortly before commencing operations replace the cold water by hot (about 150° Fahrenheit) and allow the paper to remain in it for half an hour, the object being to render the transfer paper quite supple and to expel all air, which, in the shape of bubbles, might prove a detriment. The tissue printed in the usual way is immersed in cold water until limp. Now remove the transfer paper from the hot water, laying it face upwards on a smooth rigid surface, such as a glass or zinc plate, and thoroughly flood it with cold water.

The soaked tissue is now carefully brought into contact

face downwards, a few light, firm strokes of the squeegee being required to expel any air-bells and secure complete adherence.

The adherent tissue and transfer are then placed between blotting boards for twenty minutes to half an hour before development, which is conducted in the usual manner.

The principal points to observe are:—

1. To remove the tissue from the mounting water as soon as it becomes limp.

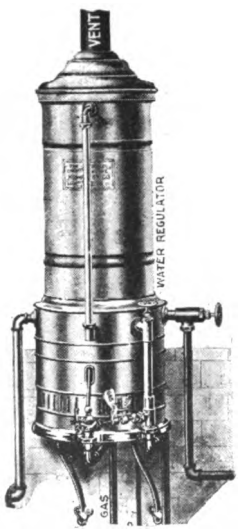
2. To use a soft squeegee, firmly, but without too much force.

3. Remove the backing paper from the tissue as soon as it will readily come away.

4. In hot weather the alum bath used after development, to be kept cool. If the film appears at all tender after development it is best to allow the print to dry first and treat with alum afterwards.

CHAPTER III.

HOT WATER SUPPLY.



INSTANTANEOUS WATER HEATER.

IT IS usually thought by those not familiar with the developing manipulations of the carbon process that it requires an abundance of hot water for that purpose, and that it is necessary to construct elaborate and expensive apparatus and machinery to furnish an adequate supply. This is a false impression. While it will be found good policy to always have in readiness more than a sufficient quantity, the supply need not be so great. For a couple of dozen small prints an ordinary kettle full heated on an oil stove will answer very well. For a professional who does a moderate amount of work a small tank, such as an ordinary wash-boiler, will furnish a plentiful supply. A small geyser constructed as follows, will be found an excellent contrivance for heating water in a continuous flow direct from the hydrant.

Into a stout tin or copper reservoir of cylindrical shape, having a firm, stout bottom to it, is placed a coil of thin copper or block tin pipe, so arranged as to let the water enter at the top, and passing through the coil, leaves it at the bottom. This arrangement is placed upon an ordinary stove, or may be heated with a gas or oil stove, whichever is the most convenient.

When wanted for use, fill the reservoir with water and when heated to a boiling point turn on the water and let run slowly—keep the water boiling.

A steady stream of hot water will be supplied by this simple contrivance which may be led to the developing tank or wherever it is required.

Besides being very convenient to move about, this piece of apparatus has the advantage over one having an iron pipe, coiled around the inside or outside of a stove, that the water passing through the lead pipe will not clog up with a rust or alkali sediment and stop the flow.

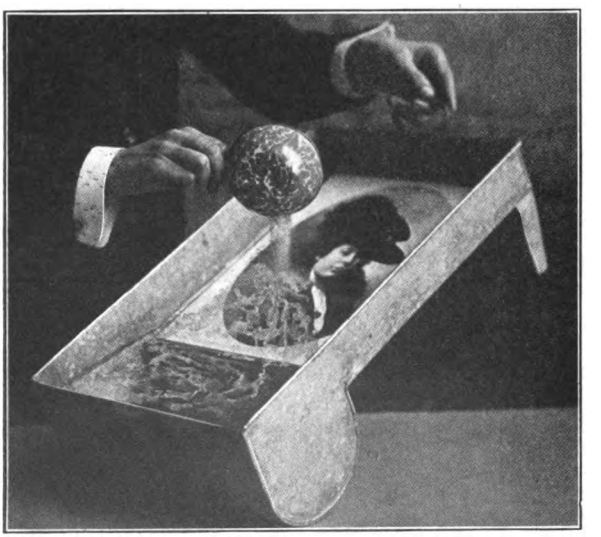
There are a number of types of geysers, or instantaneous water heating apparatus of this style manufactured; mostly with coils of iron pipe on the inside, or around the outside of furnace like arrangements or large stoves. These are suited for large carbon printing establishments where hot water is required in a continuous flow.

The new instantaneous water heaters now on the market, have a capacity sufficient to supply enough hot water for ordinary gallery use, and are cheap and very convenient.

CHAPTER IV.

THE DEVELOPMENT—PRELIMINARY REMARKS.

ALL THE operations prior to the development of the latent image, are exactly the same, no matter whether intended for single or double transfer, or what the nature of the support may be.



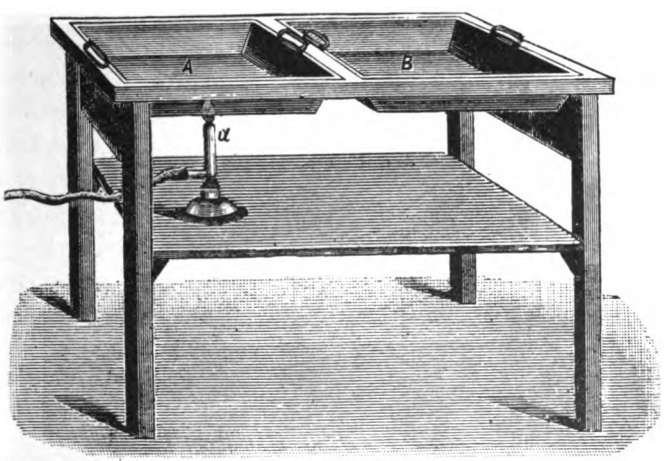
DEVELOPING OPERATION.

The greater part of the single transfer pictures are developed on paper, which is probably the cheapest and best to use for ordinary studio work, because it involves fewer manipulations and is therefore less difficult to manage, and, with ordinary care, gives uniformly good results.

For the above reason it is especially recommended to those making their first attempts at carbon printing. There are, as I have previously stated, quite a variety of excellent supports that may be employed for this purpose, such as matt-surface celluloid, porcelain, china, opal glass, and the finer grades of baryta paper. For artistic effects, rough drawing paper and a paper supplied by the manufacturers of carbon tissue called etching paper gives fine results. Carbon pictures on celluloid or porcelain are very beautiful, and at present are the popular fad among the swell people.

The smaller sizes of carbon pictures, developed with clean-cut margins on the heavier grades of celluloid, are rich and elegant in appearance, and are quite ready for delivery, unmouted. In that way they are excellently suited for the album, for which purpose they are greatly preferred to pictures mounted on clumsy cards.

The double transfer method of development is employed for pictures printed from ordinary non-reversed negatives, from which it is expected to produce pictures having a cor-



ARRANGEMENT OF DEVELOPING TRAYS.

rect or non-reversed position. To accomplish this, the exposed tissue is first transferred to a temporary or intermediate support, upon which it is developed, etc. From this temporary support it is again transferred to a final support, which brings the image into its correct position.

By the latter method, pictures may be transferred to almost any kind of support having a surface smooth enough to allow the film to be brought in perfect contact therewith; usually paper, opal glass, ivory, metal, wood, canvas, etc.

THE DEVELOPMENT.

When the transferred prints have remained under pressure the required length of time, the following order of manipulations will be found necessary for the successful development of single transfer pictures:

First immerse the adhering tissue and support into a tank containing water at about 70° F. and allow it to become well saturated, which will, however, take but a few minutes.

During this time carefully remove all the air-bells that gather on the back of the tissue and also on the transfer paper, with a camel's hair brush or sponge; but never use pressure enough to cause spots on the picture after development. The tissue is immersed in cold water first, as a matter of precaution, for the reason that the most common fault with beginners in carbon printing is the tendency to use water too hot. The safest and best plan is to begin with water at about 80° F. and increase the temperature gradually, or, if after the transfer, the print has rested under pressure for fifteen or twenty minutes, is immersed in cold water for a half hour or even an hour, it will develop very readily in water of a moderate temperature, providing of course the tissue was in good, soluble condition.

Sometimes when the tissue is immersed in water of a

high temperature at the start, the film will be totally covered with minute little air-bells, caused by the sudden expulsion of air from the tissue by the hot water, of which usually enough become imprisoned to cause trouble.

It is for this reason that we first immerse the transferred tissue in cold water; it permeates the paper and film and thus expels all the air that is present, but does not develop the image. At the same time it dissolves and washes out a good part of the bichromate and in that way prevents any trouble that might arise from that source.

It is prudent to start the development in water of about 90° F. and raising the temperature gradually until the dark pigment begins to ooze out around the edges of the tissue, which is a sign that the gelatine has become sufficiently soluble to allow the paper or original support to be removed from the back of the tissue. This takes place according to the state of solubility the tissue happens to be in. If in good soluble condition, usually at 95° or 100° F., otherwise at 105° or 110° F. or higher.

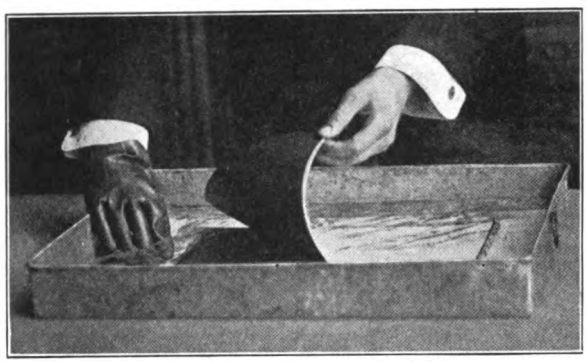
Should this sign fail to appear within ten minutes raise the temperature gradually until the desired effect has been produced, which should be between 100° and 110° F. and at the highest at 130° F.

When the pigment begins to ooze out freely all around the edge of the tissue the paper may be safely removed from the gelatine film.

At this stage the tissue has been rendered almost entirely insensitive, and light may now be freely admitted, to enable the operator to clearly observe the progress of the developing image, as it gradually emerges from beneath the dark mass of pigmented gelatine.

The water in the developing tray must stand deep enough

to allow the tissue to be easily and safely handled under its surface.



REMOVING THE PAPER

When removing the paper or original support from the pigment film, place the fingers of the left hand firmly upon the upper margin of the support, and with the right hand take hold of the upper left hand corner and with a gentle, but steady motion, remove the paper by pulling it diagonally across to the lower right-hand corner. Do not hurry this operation, but proceed cautiously, and if the paper is removed with difficulty, on spots, wait patiently until the gelatine becomes sufficiently soluble, and then proceed carefully until the paper has been removed. Usually, when the tissue is in good soluble condition, the paper is removed with ease, in fact it fairly drops off.

The paper thus removed has served its purpose and is of no further use. Fold it, gelatine side together, and throw it aside.

The film at this stage must remain carefully submerged, and not allowed to come to the surface until most of the bichromate has been washed out, and the development of the image has well progressed.

If this is not done, and the film exposed to the air for any length of time, reticulation or a very fine froth, causing tiny little air-bells, will cover the entire surface, and will totally ruin the picture. Sudden changes of temperature must also be carefully avoided. Cold water poured upon a print at this stage will cause a bad reticulation, or granulation of the film.

The now exposed mass of pigmented gelatine is immediately acted upon by the warm water, which gradually dissolves all the unaffected gelatine, and with it, washes away the pigment it contained; thus revealing the image as the development progresses.

When the removal of the paper, or original support has been affected at a temperature of about 100° to 105° F., it is prudent, at this stage of the development, to lower the temperature of the developing tank to about 90° F. until it is seen from the action of the hot water, whether the tissue was correctly exposed or not. If the image begins to clear up very rapidly the tissue has been under-exposed, and if it is possible to lower the temperature, quickly, the print may be saved by developing it in water of about 80° F.

When the removal of the paper from the back of tissue which was known to be in good soluble condition before exposure, takes place with difficulty, even in water of a high temperature, it is evident that the tissue had been rendered insoluble, or partly so, from over exposure or the continuous action of light. When this is found to be the case, raise the temperature gradually until the paper will strip without injury to the film, and then lower it to about 90° F. until the bichromate has been well washed out. Then again, raise the temperature gradually to a degree that will affect the solubility of the gelatine sufficiently to free the image of its superfluous pigment.

When hot water at 150° F. fails to have the desired effect, the only remedy left is to apply an alkali; such as borax, ammonia, carbonate or bicarbonate of soda; or, the chlorides of sodium, magnesium, barium, or zinc. These must, however, be used with care, especially those having an alkaline reaction, such as ammonia, on account of their liability of producing granularity or reticulation.

The safest way to use these chemicals is to employ them in a very mild form, and let the action be long. I greatly prefer carbon-reducine to any of the alkalies on account of its mild and safe action. Common salt may be used to advantage, but chloride of magnesium gives finer results. The judicious use of the chemicals named, especially the carbon-reducine, will, in the majority of cases accomplish the desired results.

Hot water applied locally with a vessel having a long spout to it or with a small spray will effectually clear up dark masses of clogged up shadows, and will materially aid a tardy development.

If the tissue has been prepared under favorable conditions, and the exposure was fairly correct, the gelatine will readily yield to the action of warm water, and will allow the paper to be easily removed. The image will clear up rapidly and the development will be accomplished without the least difficulty. The resulting pictures will appear with brilliant high lights, fine gradations, beautiful half-tones and soft, velvety shadows. Allow the picture to remain in the developing tank long enough to completely dissolve away the soluble gelatine and wash out all the loose pigment. When this has been thoroughly done, pour some clean water of about the same temperature as that of the developing tank, over the picture and allow it to drain. If there is no

coloring matter in the drip, the development may be called complete.

The newly developed print is then placed into a tray of clean, cold water (at about 60° F.) for a few minutes to stiffen the film, before it is put into the alum bath.

It is well to be reminded here, that to obtain bright, clear pictures from thin, delicate negatives, it is necessary to employ perfectly fresh tissue, sensitized on a bath of medium strength; old tissue employed for negatives of this kind will yield flat, sunken-in appearing pictures; and that dense, hard negatives requires tissue several days old, and must be sensitized on a bath of good strength. If a tissue suitable for the latter class of negatives is not on hand, expose a piece of new tissue to a diffused light for a few seconds to cause a slight insolubility over the entire surface. This will soften the harsh lights and will prevent the detail from being destroyed by the hot water, and a soft, delicate picture will be the result.

On the other hand, if a fresh tissue would be used, without taking these precautions, a harsh, chalky, black and white picture, devoid of all detail or half-tones would be the result.

One more important item should be mentioned here, namely: the difference in solubility of the different pigments, or coloring matter used in preparing the tissue. Some pigments are much more soluble than others and dissolve and wash away quite freely. When this is found to be the case due allowance should be made therefor by prolonging the exposure of the tissue while printing under a negative. Expert carbon printers when using tissue of this kind, usually overprint a little, and towards the end of the development employ water of a high temperature. In this manner the resulting pictures will possess finer gradation and will ap-

pear more brilliant throughout. This will be found especially true where there are masses of fine lace and white draperies.

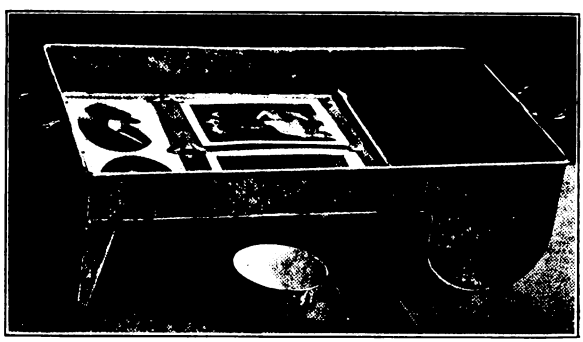
During the development care should be exercised in manipulating the prints not to allow the hands to come in contact with the soft, gelatinous surface, for it is very easily injured when in that condition.

It should be borne in mind that carbon prints always dry down a little darker than they appear in a wet state, therefore, in order to have the proper intensity they should appear just a little lighter when in a wet state.

CHAPTER V.

MARTON'S PERFECTION DEVELOPING TRAY.

MOST unsuccessful attempts at carbon printing may be attributed to the lack of proper developing arrangements, or the use of crude and impractical methods and apparatus, such as are employed by carbon printers of the old school.



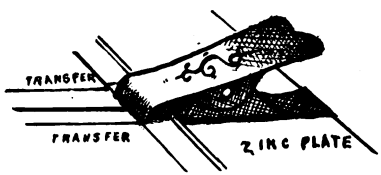
MARTON'S PERFECTION DEVELOPING TRAY.

For the ordinary run of studio work there has never been a better arrangement known than our Perfection Developing Tray. This is probably the most practical piece of apparatus ever invented, for ease of manipulation and rapid development of carbon pictures. It may be constructed of copper, which makes the lightest and neatest looking tray; but, where economy is an object, galvanized iron will answer the purpose just as well and will cost less than half as much.

The size is immaterial; it may be large or small, to suit the purpose of the operator. Where carbon printing is carried on extensively, it is of course, necessary to have a number of these trays made in various sizes.

Referring to the above cut, it will be seen, that one end resembles an ordinary tray; attached to the opposite end is a reservoir A, which must be made deep enough to hold a good quantity of water, and be rounded at the bottom, so that it may be easily tilted or rocked, to agitate the water. A small gas stove, placed under the reservoir, will serve to heat the water and keep it up to any desired temperature during development.

At C, where the tray joins the reservoir, is a narrow strip or bar ¾ of an inch high; this keeps the zinc plate that holds the pictures, in place, and at the same time forms a tray deep enough to keep the prints under water.



RETAINER CLIP.

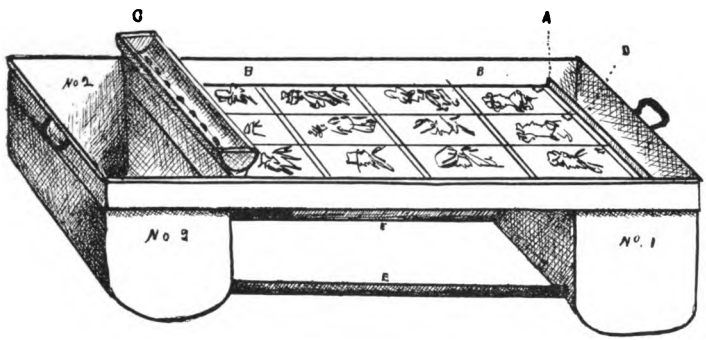
The cut to the right shows the retainer or little clip used to hold the pictures in place. These are soldered onto a sheet of zinc, a suitable distance apart, to hold any given size print by the four corners; there may be one or a dozen, owing to their size.

The transfer paper or celluloid, must of course, all be of a uniform size.

Small pictures are placed close together as shown in the cut, and one clip holds two prints, where they join.

These clips should not be of the light flimsy kind, but should be well made and have a good, strong spring.

Leger & Son, Chicago, make the best clip for the purpose, or they may be bought in any window-display fixture store.



DEVELOPING TRAY.

The above cut shows the same tray with a reservoir at each end—Nos. 1 and 2. These are connected by pipes E. E. At A. we have a narrow bar, a ½ or ¾ inch high, which forms a shallow tray B. B.

The prints for development are placed into the tray as shown in these cuts. The water is dipped out of reservoir No. 2 and poured into the funnel shaped trough C. from which it flows down over the pictures with enough force to carry all the soluble gelatine and pigment with it, into reservoir No. 1 at D; where it is again warmed up to the proper temperature, and finds its way back into reservoir No. 2. From which it is again poured over the prints—and is thus repeated until the pictures are developed.

The funnel or trough may be supplied with muslin or cheese cloth, to filter or catch the coarser particles of pigment or dirt that may be floating in the water.

To use the above apparatus, transfer the prints in the usual way; if on paper, let rest for ten or fifteen minutes; on celluloid, twenty or thirty minutes (in summer, cut the time short.) Then place them in rotation in cold water for at least ten or fifteen minutes—but an hour will do no harm.

This will expel the air and make the gelatine easily soluble, and consequently a quick development.

Dip the water from the reservoir and pour it over prints at the upper end of the tray; from whence it flows down over the prints, back into the reservoir. Repeat, and rock the tray to agitate the water.

An instructor of carbon printing recently paid me a visit. He had traveled extensively and had charged fifty to seventy-five dollars "a clip" as he called it to "put the boys on."

During his conversation he said, "Now you know very well, that all a good carbon printer can do is to get off fifteen or eighteen good prints a day, and it hustles him to do that." Before he could say any more, I motioned for him to follow me and I took him to the developing room, where, as it happened, I just had a lot of carbon prints transferred, ready for development.

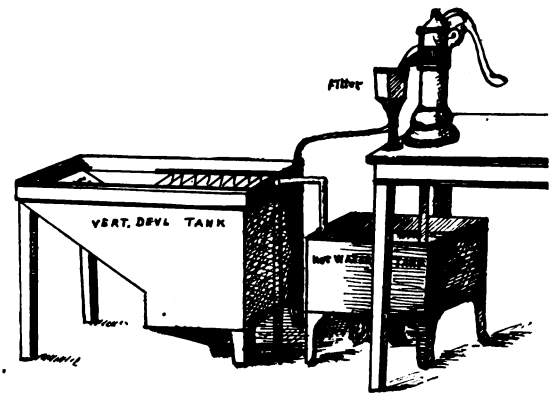
I got out my perfection developing tray and filled the reservoir with warm water; then I took down a retainer for 16 cabinet pictures and filled it with the transferred prints and started to develop.

In a remarkably short time, I had sixteen sparkling carbon prints on the plate.

My visitor was dumbfounded, and when he regained his speech, he exclaimed, "Sixteen, by thunder, and every one perfect, and you never touched them!" He then began to wonder why in the world he had never thought of such a simple arrangement himself. He felt just like bumping his head. Here he had worked and worried for twenty years over one little picture at a time, which, in the majority of cases, had to be made over to get a perfect print. He asked my consent to use the developing tray, and with a few other pointers he went away rejoicing.

There are hundreds of professionals who are plodding

along in just the same way—were probably taught by just such a fellow as the one that called on me.



THE PERFECTION VERTICAL DEVELOPING TANK.

THE PERFECTION VERTICAL DEVELOPING TANK.

For a carbon plant or work on a more extended scale, the vertical developing tank (Fig. 28), is probably the best piece of apparatus ever invented. It lessens the developing manipulations to a great extent and makes it possible to develop two, three or five dozen prints, simultaneously, without splash or muss.

This is a great advantage over the old method and enables the printer, not alone to turn out a vastly greater number of prints in a day, but his work will be greatly superior, and the loss of prints from over-exposure will be reduced to a very small per cent. A great number of carbon printers in this country and in Europe, speak very highly of its efficiency and have permanently adopted it for their establishments.

A glance at the above diagram will give a clear idea of its construction. The vertical tank proper is arranged to the right; on the left or slanting side, is placed a movable plat-

form hinged at the end of the tank, and is so arranged as to allow the end projecting into the tank to be raised and lowered at will.

The water supply pipe is arranged at the end and sides of the deep part of the tank, and is fed by a double pipe arrangement leading from the hydrant and hot water apparatus. By means of the faucets, water at any desirable temperature may be supplied to the tank. The water enters at the top and passes down and out through the opening at the bottom. A waste pipe leading from this opening is so arranged as to keep the water up to a certain level while the pictures are in process of development.

When this apparatus is put to use it is first filled with water at about 90° or 100° F. and the platform raised to the level.

Work is commenced by taking the transferred prints from the cold water tank and placing the same into the reservoir of the developing tank, where it remains until the pigment begins to show signs of softening. When the dark pigment begins to ooze out freely around the edges of the tissue, it is transferred to the platform of the tank, where the original support is removed from the tissue. The movable end of the platform is then detached and allowed to drop down into the water, which enables the operator to remove the print now resting on its new support to the deep end of the tank, where it is suspended in a vertical position, without necessitating its removal from the water or exposing it to the atmosphere in that condition.

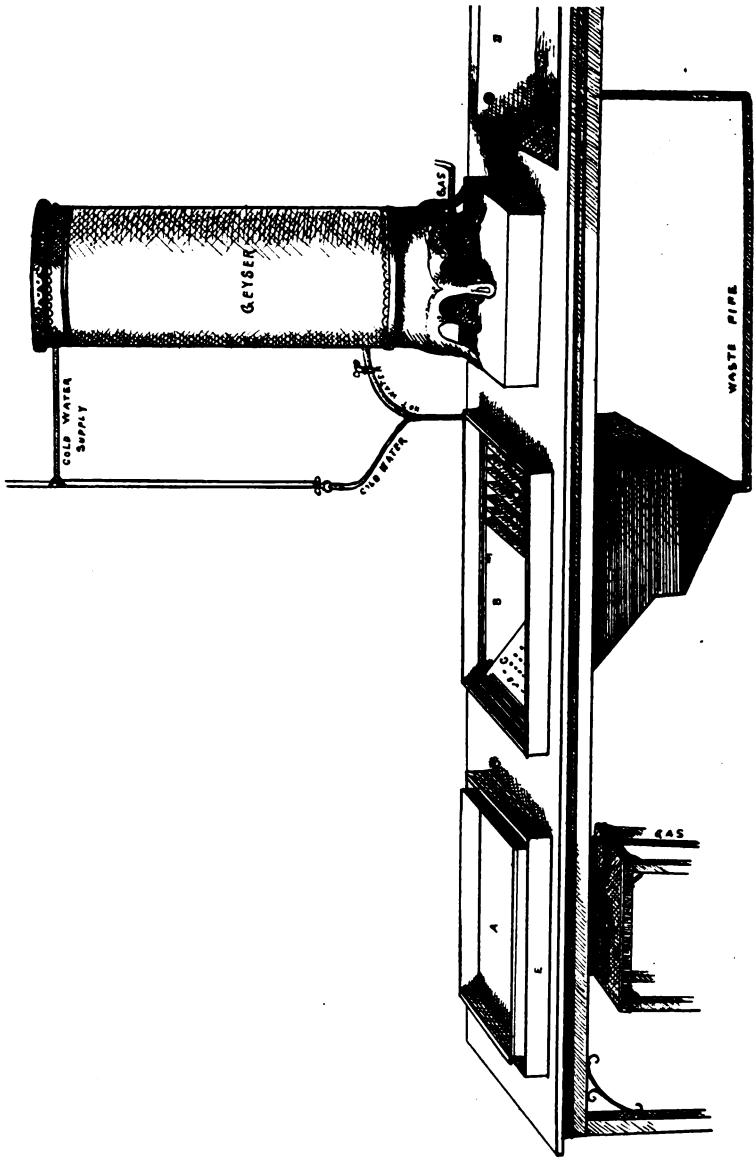
The development of carbon pictures resting upon paper or thin celluloid supports is done by fastening the transferred prints on sheets of tin or zinc, having spring clips or retainers by which to fasten one or a dozen prints, as the case may be, and are so arranged that they may be suspended from fasten-

RETAINER.

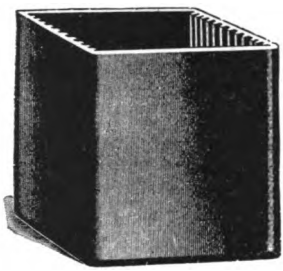
ings on a bar placed across the tank. All the transferred prints are treated in exactly the same manner, and when the last piece has been suspended, the water is turned on quite briskly. The force or downward flow of the water washes away the bichromate and carries down with it all the soluble gelatine and the coloring matter contained therein, and thus clears and develops the image in the most perfect manner. As soon as the bichromate has been well washed out and the image begins to clear, the picture may be lifted from the water, to observe the progress of the development. If some of the prints show signs of under exposure, lower the temperature to a suitable degree until all the weak prints have been developed, which are then removed to the cold water tray or tank; and the temperature again raised to a degree suitable to complete the development of the remaining prints.

Should any of the pictures be much too dark or require local development, place them into a perfection developing tray and apply water of a high temperature, to those parts that need clearing. After giving this piece of apparatus a fair trial, its advantages over the old method will be apparent. Aside from being cleanly, it lessens the labor by shortening the development to a wonderful degree; then, too the pictures are not liable to be injured by handling during the process of development.

When once suspended in the tank they are not disturbed, and need no further attention, (unless there are some that are undertimed,) until development is complete.



ARRANGEMENT OF TRAYS, TANK AND HOT WATER APPARATUS.



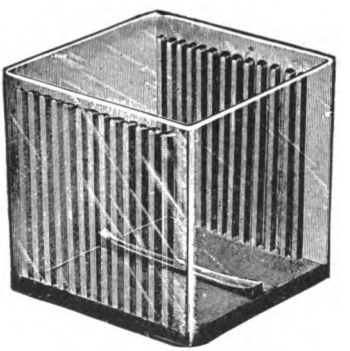
VERTICAL TANK.

Whenever the vertical developing tank is employed, it is necessary to also have vertical tanks in which to suspend the developed pictures.

These tanks may be made of wood and lined with rubber or oil-cloth for the alum bath, for large pictures; for small work, the ordinary negative fixing bath holder may be used. Tin or galvanized iron does very well for hot or cold water tanks.

CHAPTER VI.

THE DEVELOPMENT OF CARBON PICTURES ON HEAVY CELLULOID, PORCELAIN OR OPAL GLASS.



ALUM TANK.

The best and most expedient way of developing carbon pictures on heavy celluloid or porcelain glass, is by the tank method.

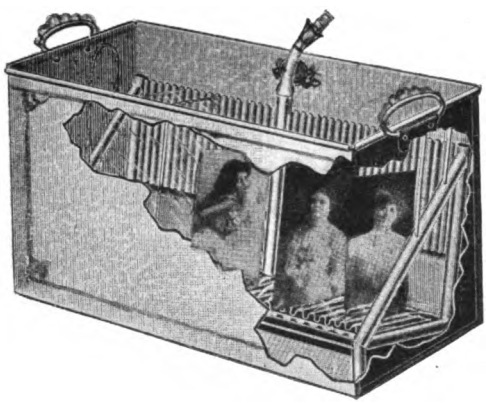
These tanks or bath-holders are made similar to the tanks commonly used for hypo or negative fixing baths, and are probably the most convenient piece of apparatus that could be devised for the purpose.

They may be made any size, large or small, to suit the purpose or convenience of the operator. The 4x5½ and 5x7 plates are probably the most popular of the smaller sizes, and for these the ordinary fixing baths may be made use of, especially for the alum and clearing solutions.

The hot, as well as the cold, water tanks are best made of galvanized iron or copper, and can be had at a small expense.

The mode of development is very simple. About 15 or 20 minutes after the transfer has taken place, fill a tank with clean, cold water at about 60°F. and drop the plates or celluloid into the grooves. See that no air-bells gather on the

back of the print when first introduced. It is immaterial how long the prints remain in the cold water before development; ten minutes, an hour, or even two or three hours, will do no harm; but in a prolonged immersion, it is best to change the water at least once or twice, to get rid of the bichromate. The development may then take place to suit the convenience of the operator.



DEVELOPING TANK

When ready to begin fill a tank with water at about 105° F. and then take the transfers from the cold water and drop them into the grooves of the hot water tank. If there are any signs of froth or air-bells gathering on the backs of the prints, pass over each transfer with a brush or soft sponge.

When the gelatine softens and the pigment begins to ooze out quite freely, around the edges of the print, remove the plate to a tray containing water at about the same temperature of the hot water tank; then carefully remove the paper from the film and immediately return the plate to the tank. Proceed in like manner with all the other plates, then

let them remain in the hot water until the unaffected gelatine is well dissolved; then take them again in rotation, and place them into a perfection developing tray of a suitable size; a tray-shaped arrangement designed purposely for clearing carbon pictures of their superfluous pigment.

If the tissue happens to be in a good, soluble condition, a few dashes of warm water, dipped from the reservoir, will suffice to quickly clear up the print, and complete the development. Should it act a little slow, however, raise the temperature of the water gradually, to a degree that will produce the desired effect.

Over-printed pictures may be reduced by a continuous soaking in hot water; should this remedy fail, however, add a little of a 10 per cent solution of carbon reducer to the hot water. Be careful of an overdose of this reducing agent; add it slowly, and in small quantities until the picture has sufficiently cleared up. The action may be stopped immediately by plunging the plate into clean water at a moderate temperature. Should this reducing agent fail to have the desired effect, then the picture is beyond redemption, and may as well be discarded. Clean the plate while the film is still in a soft condition. After the development, rinse the pictures well in clean, cold water and place them for five minutes into a well-filtered solution (3 per cent) of common alum. Rinse in five or six changes of perfectly clean water and place them on a rack to dry.

Should the pictures lack in clearness, or pureness of tone when taken from the alum bath, immerse them for five minutes in a three per cent antichrome clearing solution; then rinse and place them on a rack to dry.

CHAPTER VII.

CARBON PRINTING IN HOT WEATHER.

DURING the hot days of summer the carbon printer often finds it a very difficult task to obtain satisfactory results by ordinary means. He is therefore obliged to resort to various methods to overcome the difficulties brought on by an excessively high temperature.

In the first place, we must have a room that is reasonably cool and dry in which to sensitize and dry the tissue; the latter must be done in as short a time as possible. The printing must be done in the shade, or by electric light, for which the aristo lamp comes into splendid advantage now. Thin negatives, but snappy and full of details, are the proper thing for hot weather printing; they require a weak bichromate bath, and can be easily and quickly printed in the shade. The developing may be done in a cool basement even though it be a little damp; but if such place is not available, plenty of cool water (ice water) is all that is necessary.

In extremely hot weather, the sensitizing bath must be weak in bichromate, and contains a good per cent of ether and alcohol with a few drops of a 10 per cent solution of bichloride of mercury added. The tissue may also be coated with plain collodion to prevent reticulation. This is done by fastening the tissue to a tablette or suitable board with thumb tacks. Coat it with a 1 or 1½ per cent collodion; flowing the collodion over the tissue after the manner of coating a negative plate with varnish. Immediately after the collo-

dion has set, take the tissue from the board and immerse it in clean, cold water; agitate the water until all the greasy lines have disappeared and the water flows smoothly over the surface. It is then taken and hung up or placed, face up, on a board or plate of glass, so inclined as to drain the water well from the surface; for the squeegee cannot be employed on account of the very tender surface of the collodion film.

After the tissue has become perfectly dry, go over the surface with a waxing solution, after the manner of waxing a paper temporary support; this must, however, be polished in a way that nearly all the wax is rubbed from the surface. The paper is then ready to be sensitized the next day.

The sensitizing is done in the usual manner with the exception that the bath is much weaker and is used at a very low temperature. The squeegeeing is omitted on account of the collodion film, and the tissue is hung up in a current of pure air to dry.

Tissue prepared in the above manner is of course intended for double transfer pictures; and must therefore, after exposure, be transferred to a waxed temporary support for development.

Another, and probably a more simple method is the following: A perfectly clean glass is coated with ox gall 1 part, water 5 parts, and is allowed to dry. When dry, coat again with albumen 1 oz., water 10 oz., bichromate of ammonia 1 dram. When dry, expose the plates to a strong light for about 10 minutes or longer, to make the film insoluble, and the plate is ready for use. When the pigment tissue is taken from the sensitizing bath, it is squeegeed against the albumenized plate, which is then placed in a good draught to dry. When dry, it will strip from the plate with a smooth, brilliant surface and will give splendid contact to the negative.

Tissue prepared in this manner is intended for single transfer pictures: The insoluble albumen film over the surface of the tissue will hold and preserve all the details of the negative and will effectually prevent reticulation and granularity.

For the best results, use the bath containing ether and alcohol and make up a new bath for each bath of tissue. Dry the tissue in a drying box having an exhaust fan attached to it.

For quick or immediate work in hot weather, the new chromic sensitizer referred to in Chapter XI, page 50, is probably the best and most convenient to use. The tissue dries out very rapidly, and is ready for printing just as soon as dry.

Make the transfer in a tray deep enough to allow all manipulations, such as turning, brushing over the surface of the film and attaching it to the support, to be done under the surface of the water. Give the tissue time to fully expand or until it begins to turn backward, before placing it upon the support.

The methods given above are, of course, extreme measures, which may be resorted to should the ordinary methods fail to give satisfactory results.

CHAPTER VIII.

THE USE OF ACIDS AND ALKALIES IN DEVELOPMENT.

ACIDS and alkalies are frequently made use of in the development as well as the reduction and clearing up of over-printed carbon pictures.

Hydrochloric Acid.—Over-printed carbon pictures that will not yield to the action of hot water, if first treated to a bath of hydrochloric acid in a one per cent solution, will then readily yield to the action of hot water, and the desired reduction will be easily accomplished.

Sulphuric Acid acts a little more energetic than hydrochloric, but the general effect is about the same.

Nitric Acid is sometimes used for the same purpose, but attacks the gelatine rather forcibly. Therefore, on account of the milder action of hydrochloric or sulphuric acids, these are preferable.

Acetic and Citric Acids give similar results to those obtained with mineral acids; but in a very diluted state, their action is much slower. A strong solution of acetic acid will, however, develop a carbon picture in a cold state.

Liquid Ammonia attacks bichromated gelatine quite forcibly and must be used with care. A few drops added to the developing water will clear the image very rapidly.

Carbonate of Ammonia acts similar to the liquid ammonia, but its action is considerably milder and much slower.

Carbonate of Soda is a little milder in its action than ammonia, and has certain good qualities that recommend it to the careful worker. A one, to three per cent solution works moderately and is very easily controlled—the action may be

stopped at a moment's notice. It is therefore preferable to ammonia.

Caustic Potash and Soda quickly reduce a bichromated gelatine film, and therefore on account of their too forcible action, are unsuitable as reducers for over-printed carbon pictures.

Chloride of Sodium is very mild in its action on exposed carbon tissue and is mostly used to clear up slightly over-printed pictures.

Borax and Borasic Acid have a very mild effect on carbon prints, and the action is very easily controlled.

Chloride of Lime is highly recommended as a reducing agent for over-printed carbon pictures, but many printers prefer sodium chloride for a slight reduction. The action is milder and better under control.

Sulphocyanide of Potash and Ammonia will develop pigment tissue in cold solution, but the action is slow and uncertain. A small addition to the hot developing water will aid materially in cleaning up and forcing a tardy development.

Barium Chloride in a cold aquaous solution will develop carbon pictures but must be used with great care and judgment. If used to excess it will dissolve the entire film.

Bichromate of Potash will dissolve the unaffected gelatine, but its use is restricted more to photo-mechanical printing than the carbon process.

In conclusion, it is well to mention that both acids and alkalies—the latter especially, must be used sparingly—in weak solutions and at a rather low temperature, to avoid reticulation or granulation.

GENERAL REMARKS.

The most perplexing difficulty met with by the beginner in carbon printing, is insolubility of the tissue.

This vexation will prey upon his efforts until he learns by practical experience, how to take proper care of his bichromate solutions and how to protect the sensitive tissue from foul air and dampness, and against exposure to such light as would set up a hardening action, no matter how faint it appears to be.

While a slight exposure to white light would probably not prove injurious to the printing qualities of tissue intended for immediate use, it is well to bear in mind that the action is continuous; no matter how silght the exposure appeared to be, it will in time, penetrate the whole film and cause total insolubility.

A very frequent cause of insolubility is the excessive use of—and sometimes a poor quality of—bichromate, in the sensitizing bath.

It is best to use only the chemically pure and renew the solution frequently.

The strength of the bath should be used with due regard to temperature and climatic conditions, and, when employed at a high strength, the superfluous solution must always be carefully removed from the film before drying, by squeegeeing it down upon a clean glass plate; and from the back by the use of a good blotting paper.

Drawing the tissue over glass rods must only be resorted to when the temperature of the solution is low (45° F.) in cold weather.

Slow drying in a warm, damp atmosphere is also a frequent cause of insolubility. The air should be kept in motion and a medium to absorb moisture employed.

Another source of trouble the inexperienced carbon

printer has to contend with, and one that often tries his mettle, is the reticulation and granulation of the film, and the pest of blisters or tiny little air-bells that sometimes cover the entire surface of the picture, both single and double transfer.

Reticulation is brought on through various causes. Drying the tissue too rapidly and leaving it exposed to the influence of foul air or gases, is a common cause. Making the transfer in water of an unsuitably high temperature, and not allowing the tissue and support to remain in contact long enough before development, is another.

The cause of the most frequent occurrence of this trouble, however, is found in the sudden changes of temperature that take place in the water of the developing tank. Always raising or lowering the temperature gradually, is the obvious remedy.

To avoid reticulation in hot weather, do not forget to add 100 grains of salicylic acid or a few drops of a ten per cent solution of bichloride of mercury to the sensitizing bath.

When used at a low temperature, and the tissue is dried out quickly, no trouble from this source need be expected.

Granulation is frequently the outcome of an excessive or careless use of alkali in the sensitizing bath or developing tank.

A very strong alum bath will also cause a similar trouble.

Blisters and minute little air-bells are another source of annoyance that will puzzle the novice considerably during his first attempts at carbon printing.

These little pests appear from various causes, and may easily be remedied. Blisters occur most frequently on single transfer paper and are caused mostly by creasing or breaking the paper through careless handling, and from the lack of thoroughness in making the transfer. If sufficient pres-

sure is not applied in using the squeegee, to completely expel all air from between the tissue and support, a few blisters may always be expected. A pin carefully introduced through the paper at the back is the only remedy.

In trying to light up dark parts by local application of very hot water, is another source of blisters. This variety usually ruins the picture totally.

In the greater number of cases the cause of the minute little bubbles or air-bells may be looked for at the beginning of the transfer.

If the tissue is mounted upon the support, before the film has had time to absorb sufficient water to cause it to lay flat, it will keep on swelling, and, while in the act of expanding it will absorb the water from the paper support, which in turn is replaced by air. This air, drawn into the pores of the paper, lodges close up to the film, and when the tissue is placed in warm or hot water at the beginning of the development, it immediately expands in accordance with the temperature of the water, and when it is removed from the back of the tissue the film will then appear covered with a froth. This froth may safely be attributed to the absorption of air into the pores of the paper during the expansion of the gelatine film, and is the direct cause of the little air-bells that cover a part or the entire surface of the picture.

To radically expel the air from the pores of single transfer paper, place it in clean, cold water five minutes or longer, and then lay it face down upon a smooth, clean surface, cover it with celluloid or rubber cloth, and apply the squeegee with considerable pressure.

Return it to the cold water tray face up and transfer the tissue to its surface. A print absolutely free from air-bells will be the result.

Still another cause of the little air-bells is the presence of air in the pores of the tissue, which has been left adhering to the support for a considerable length of time before development.

When tissue in this condition is placed into the developing tank the hot water will cause the air to expand and a lot of blisters or air bubbles is the result.

A safe and easy remedy for this trouble is to place the tissue into a tray of cold water for a few minutes, or longer if necessary and let the gelatine swell gradually, which will expel the air and the trouble will be avoided.

Another cause that will produce the same effect, is letting the tissue rise above the surface of the water before it has been freed from the bichromate and superfluous pigmented gelatine, at the beginning of the development. It must, therefore, be carefully kept under the surface until pretty well developed, when it may be taken out of the water and the small rose applied for local development.

When developing in the ordinary way, rock the tray or agitate the water in some way; otherwise the picture will be covered with little black specks.

It often happens that the tissue absorbs water more rapidly than usual and before the transfer can be effected it has absorbed too much.

Whenever this happens the squeegee must be vigorously applied and the mounted print put under pressure for a longer time than usual.

CHAPTER IX.

REDUCTION OF CARBON PICTURES—THE ALUM BATH—CLEARING SOLUTIONS—FINISHING.

IT FREQUENTLY happens, that, from various causes, and more especially in summer time, carbon pictures will remain too dark in spite of any ordinary remedy that may be applied. Such pictures may be redeemed by resorting to any of the following methods:

Carbon Reducine, is a chemical compound now in common use in every carbon printing establishment, and can be highly recommended as a reducer for carbon pictures; if used with judgment and care, its action is mild and safe and can always be depended upon, no matter how dark the picture. The action may be stopped at a moment's notice by simply immersing the print in clean, cold water. Make up a ten per cent solution, and dilute it according to the action desired and filter. Immerse the print into the cold solution until the proper reduction has taken place. Let the action be mild, which of course, takes time (several hours) and the picture will clear up gradually and to the best of satisfaction. Wash well in cold water and dry at a moderate temperature. If a more rapid action is desired, use hot water and add the reducer, a few drops at a time, until the desired reduction has taken place; then wash in cold water and immerse in the alum bath.

Another good reducer for carbon pictures, is sulphocyanide of ammonia, but it is considerably more expensive than the reducine and must be handled with care on account of its poisonous nature. Dissolve one ounce of sulphocyanide

of ammonia in 100 oz. of pure water and add one drop of liquid ammonia. Immerse the print and rock the track until it is sufficiently reduced. If the action is not too rapid, the image will clear up nicely without showing any granularity or in any way effecting the quality of the picture.

Persulphate of ammonia is another very effective remedy for carbon prints that remain too dark. To 32 oz. of pure water add 2 dr. of sulphuric acid c. p. To this add 125 grains of persulphate of ammonia; immerse the dark print in this solution for a half hour and then proceed with the development in hot water as before. When sufficiently reduced, treat the print to a 5 per cent solution of sulphate of sodium and rinse in clear water.

Prof. R. Nemais recommends an acid permanganate of potash reducer:

Permanganate of potash	0.5 gram
Sulphuric acid C. P.	1 c.c.
Water	1000 c. c.

Add the above solution a few drops at a time as may be required to the developing water, and observe closely the action it has on the gelatine film. When sufficiently reduced, rinse and clear the stain in a 1 per cent solution of oxalic acid.

Bicarbonate of soda is used by many carbon printers to reduce over-printed carbon pictures, when water at a high temperature fails to have the desired effect.

Before the introduction of carbon reducine, a favorite reducing agent in many establishments, was chloride of lime. A little of a saturated solution added to the developing water will usually have the desired effect. Its action is very mild and it does not cause softening or granularity of the film like some of the other chlorides.

Use at a low temperature and let the action be slow.

THE ALUM BATH—CLEARING AND FINISHING.

When the development of a carbon print is complete, immerse it in cold water for about five minutes, and then into a solution of alum and sulphite of soda; for the purpose of hardening the film and removing every trace of yellowness caused by the bichromate still remaining in the film and support, which, if it were not thoroughly eliminated, would be a great hindrance to the permanence of the picture.

On account of the extreme solubility of bichromate salts in a solution of sulphite of soda and common alum, a three or four per cent solution is usually employed by most carbon printers for this purpose.

Dissolve three ounces of common potash alum (powdered) and two ounces of sulphite of soda in 100 ounces of soft water, and filter well. If hard water is used, add a few drops of sulphuric acid, to clear the solution before filtering. An immersion of about 10 minutes will be sufficient to remove all traces of bichromate, and will thoroughly harden the film. Heavy, rough supports require double the time that thin ones do; and heavily coated baryta paper requires at least an hour to eliminate all traces of bichromate in the film.

When using a plain alum bath it is advisable to use none but fresh solutions for each batch of prints.

A two per cent chrome alum solution may be substituted for the ordinary potash alum, if a thorough induration of the film is desired. This bath will make the film very hard and tough, and much less liable to injury than if the former had been used, but the elimination of the bichromate is not affected and the cost is more than double; besides a strong solution is apt to stain or discolor the print.

Sulphate of aluminum is also employed as a substitute

for common alum; but like chrome alum, does not possess any material advantage over the ordinary alum bath for hardening carbon prints.

The following makes a fine bath for pictures to be dried out quickly by heat or in the sun:

Powdered alum	6 ounces
Sulphite of soda	3 ounces
Glycerine	2 drams
Water (soft)	64 ounces

This bath has good keeping qualities and works well until exhausted. Filter well through cotton before using.

Carbon pictures upon paper hardened in this bath, may be handled like albumen prints after once dry. They may be re-wetted and stacked up for mounting without the least fear of injury.

When taken from the alum bath, the pictures are rinsed in cold water for about twenty minutes. This may be done in an ordinary tray, (unless there are a good many,) when it is best to suspend them in a vertical tank or bath, such as are used for negative fixing, or the vertical bath used for development. The water for this purpose ought to pass through a filter to remove all traces of sediment.

When well washed, suspend the pictures in a room perfectly free from dust, and allow a mild current of air to pass through the room. In this way they will dry out in a very short time, and are then ready to be mounted.

Carbon prints cleared in a plain alum solution may be dried out quickly, if desired, by soaking them in a bath of alcohol for a few minutes, and then suspending them in the drying apparatus, subject to a smart current of air.

Prints on celluloid should never be treated to alcohol, unless the bichromate has been thoroughly eliminated from the film. If such is not the case a greenish yellow stain will be the result. Ordinary 95 per cent alcohol must be used for

this purpose. Wood alcohol or Columbian spirit, will dissolve the celluloid.

Clearing Solution.—Some pigments are considerably affected with the bichromate and retain a yellowness that often proves fatal to the picture in the end. The bichromate affects the pigment picture in the same manner as hypo does the silver print; it does not only spoil the tone or color, but will eventually ruin the entire picture.

To eliminate all traces of yellowness and restore the purity of tone or color, as well as the absolute permanency of the picture, it must be treated to a bath of clearing solution. Make up a 5 per cent solution of antichrome and use it at about 60° F. in winter and below in summer.

Rinse the prints in several changes of clean, cold water, after passing through the clearing bath.

Finishing.—It is very important that both the film and glass side of the negative should be kept perfectly clean during printing operations, to avoid blemishes caused by dust or dirt. The retouching or spotting-out, may be done with any good spotting colors, but the best and most satisfactory results are obtained by softening a piece of unsensitized tissue of the same color as the print, in warm water, and to use the color for spotting. Specks and dark spots are cleared up with an etching tool, rubber erasers, etc.

CHAPTER X.

THE DOUBLE TRANSFER PROCESS.

THE USE of the modern stripping plate and the many easy and reliable methods for reversing the negative film of ordinary dry plates, has brought this, once the only practical method of carbon printing, almost entirely into disuse—at least with all the up-to-date carbon printers.

Of course, when it comes to making pictures upon uneven surfaces, or supports that are affected with the bichromate, the double transfer process is indispensable.

The pictures for this method are printed from ordinary non-reversed negatives to make them appear right when finished.

For pictures upon uneven or rigid surfaces, the prints are transferred and developed upon flexible temporary supports of paper; otherwise opal or plain glass may be used, according to the kind of surface the resulting picture is to have.

The flexible temporary support, is simply a good, tough paper, coated with a gelatine and shellac solution made after the following formula:

A.—White shellac .....30 grams
Alcohol .....100 c. c. m.

Dissolve and filter through paper.

B.—Gelatine (hard) .....30 grams
Water .....500 c. c. m.
Glycerine ..... 5 c. c. m.
Chrome alum ..... 1 c. c. m.

Soak the gelatine for an hour and dissolve in a hot water bath. Add this to solution A. a little at a time and stir well

at each addition. Then add the glycerine, and dissolve the chrome alum in a little hot water and after adding it, give the compound a thorough shaking up. Coat the paper with this milky solution, using a soft sponge or flat camel's hair brush. Hang the paper upon a line and when it is thoroughly dry, wax it, and it is ready for use.

The flexible temporary support, furnished by the makers of carbon tissue is especially prepared for the purpose and can be had in sheets of 18x22 or larger. If this paper support is properly taken care of, it can be used indefinitely.

Wax with the following solution:

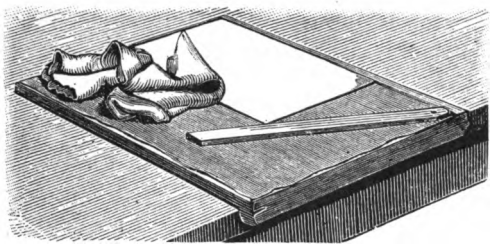
Pure wax	40 grains
Resin	24 grains
Benzole	10 ounces

Fasten the support onto a smooth surface with thumb tacks, and rub the solution over the surface with a clean flannel tuft. Allow the solvent to evaporate, which requires about ten minutes, at an ordinary temperature. Then polish with a clean, dry flannel, using a light, circular motion, to insure a smooth, even surface, and it is ready for use; but works best when a day old.

Before making the transfer, immerse this support face up in clean, cold water, and let it remain until the water flows smoothly over the waxed surface. Then immerse the carbon tissue into the same tray, and proceed exactly in the same manner as when making a transfer for development by the single transfer process.

Do not forget to remove the superfluous moisture around the edge of the tissue after each transfer, and allow at least fifteen minutes to elapse before development. If more time is likely to pass than fifteen or twenty minutes before development, lay one print over the other, and cover with a glass,

(weighted down,) to keep them moist, or immerse them in cold water until ready to develop.



POLISHING BOARD.

WAXING SOLUTIONS.

The following waxing solutions are used on plain or opal glass, and zinc plates, that serve the purpose of temporary supports for developing pictures by the double transfer process.

Through the agency of this medium the pictures are readily transferred from the temporary to the final support, which again reverses the image and brings the picture into its correct position.

There are a number of good formulas in use of which the following are the best:

No. 1. Pure Beeswax ....120 grains
Dammar varnish ..... 25 grains
Pure benzine ..... 25 ounces

Pour the benzine into a clean, dry bottle, and then dissolve the wax and add a little at a time and shake well; then add the Dammar and shake until thoroughly mixed. When dissolved let stand until well settled, and decant the clear liquid for use.

No. 2. Beeswax ....75 grains
Resin ....35 grains
Benzole (pure) .....10 ounces
Turpentine .... 8 ounces

Dissolve the wax in the benzole, and the resin in the turpentine and mix the two solutions thoroughly and let stand until clear.

The above solutions are applied to the surface of the support as evenly as possible with a flannel tuft, using slight pressure. When applied to ground glass or matt opal, nothing further need be done. A smooth surface, however, must be polished as soon as the solvents have evaporated. Polish with a clean, dry flannel, using a circular motion with a light pressure. Care must be exercised not to carry on the polishing to an extent that would remove too much of the wax. Plates treated in this manner will work best when 12 hours or a day old.

A rapid drying solution may be prepared as follows:

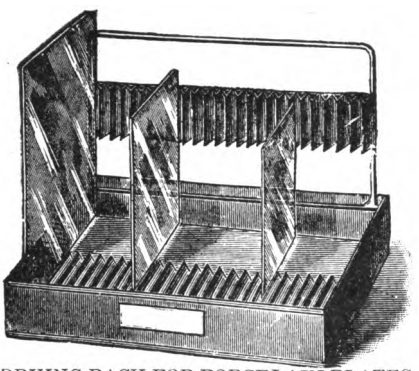
Pure beeswax	40 grains
Ether	6 ounces
Alcohol 95 per cent	2 ounces

Plates treated with this solution may be used a few minutes after its application.

To further improve the waxed surface of the support so that it will render the best results possible, immerse the waxed plates into a six per cent solution of a well filtered chrome alum, for about five minutes, after which the plates must be well rinsed in clean water and dried. This treatment will cause a better contact and will hold most perfectly all the fine details of the picture, which it renders in a most perfect manner when transferred to the final support.

CHAPTER XI.

OPAL AND GROUND GLASS AS TEMPORARY SUPPORT.



DRYING RACK FOR PORCELAIN PLATES.

FOR pictures in the now prevailing style of matt finish, it is necessary to employ a support having a matt surface, such as opal or ground glass.

The opal is preferable to ground glass on account of its white surface, which makes it possible to better observe the progress of the development; which is a great advantage, especially for beginners.

The ground surface of the glass must be made perfectly clean, in a solution of potash, and well rinsed in soft water.

When perfectly dry apply the waxing solution given in a previous chapter. This should be done in a room perfectly free from dust, and a medium temperature.

Cover the surface as evenly as possible and polish in the usual way; then immerse the plate in the alum solution as previously directed.

The most exquisite matt surface is produced upon collodionized opal glass. Dust the perfectly clean surface of the plate with talc or French chalk and rub it well with a flannel rag; then brush off the superfluous chalk with a camel's

hair duster. Coat the plates with a good transfer collodion, and when set, immerse in clean, cold water and let remain until required for use. Just before making the transfer rinse in filtered water until it flows smoothly over the collodion surface.

The transfer is made in the usual way, by immersing the tissue in the same tray, with the opal glass, and bringing the waxed surface and film in contact under water to avoid imprisoning air between film and support.

Then withdraw the support and adhering tissue carefully from the water and place it upon a level stand or table; then cover it with the rubber cloth or celluloid and squeegee, first gently, to remove the water, and then quite vigorously, to bring support and film into intimate contact.

Place one plate over the other and let them rest for at least twenty minutes or half hour before development is commenced.

Instead of flowing the plates with collodion, they may be coated with gelatine or albumen. The latter will hold all the fine details of the negative in a most perfect manner and is especially suited for carbon vignettes.

Albumen (fresh egg)	1½ ounce
Water	12 ounces
Alkaline bichromate (3 per cent solution)	2 ounces

Give the solution a thorough shaking up and filter through cotton. If let stand for a few days and then well filtered, it will flow over the talced surface of the plate as evenly and smooth as collodion.

Plates coated with this substratum may be dried by gentle heat, and are then exposed to good, strong daylight to harden the film.

Before transferring the exposed tissue wet the surface

well or immerse for a few minutes in a tray of clean, cold water.

For a gelatine substratum, dissolve one ounce of good, hard gelatine in 16 ounces of water and add enough alkaline bichromate solution to give it a strong yellow color. Flow the talced plates in the usual way and when dry expose to light to harden the film the same as the albumen plates.

CHAPTER XII.

DOUBLE TRANSFER FROM POLISHED GLASS FOR PICTURES HAVING A BRILLIANT SURFACE.

DOUBLE transfer carbons with a brilliant glass-like enamel, are probably the most beautiful of all the double transfer pictures made; but, on account of the many failures in their production, they are likewise classed as being the most difficult to make of all the pictures produced by this process.

The most serious difficulties encountered, usually arise in making the transfers; either when mounting the tissue upon the temporary support, or, when transferring the developed print to its final support.

The most perplexing difficulty, especially with the beginner, arises while making the first transfer; and is usually caused by allowing air to become imprisoned between the support and tissue, which gives rise to countless little shiny specks, and may be attributed to lack of thoroughness in applying the squeegee.

There are two different methods in use to prepare the plates for this process of development. One is called the dry, and the other the wet process. The dry process, although it take a little more time and entails a few more manipulations, is probably the least difficult to master, and for beginners, as well as for ordinary studio work, is undoubtedly the best and most practical method of the two.

After the plates have been waxed according to the directions given, moisten a tuft of filtering cotton in benzine or alcohol, and wipe away an eighth or a quarter of an inch of

the wax around the edge of the plate; then with a small camel's hair brush give it an edge of the following insoluble substratum.

Gelatine (hard)	1 ounce
Water	16 ounces
Salicylate of soda	1 dram
Formalin	1 dram

Soak the gelatine in the water for an hour; then add the salicylate of soda, and dissolve in a water bath, by gentle heat. Add the formalin, and filter through muslin.

This solution remains liquid, and will keep indefinitely, if properly taken care of.

An edge composed of this mixture will become perfectly insoluble when dry, and will hold the collodion film firmly to the plate during the developing manipulations, which otherwise would be inclined to leave the glass, which would mean ruination to the picture. As soon as the edge is dry, the plates are ready to be coated with the collodion.

The waxed plates must be perfectly free from dust, and contain no moisture.

The room used for coating should be dry and have a temperature not above 65° or 70° F.

Coating plates with enamel collodion is done in exactly the same manner as flowing a plate with varnish or similar solutions; by balancing the small plates on the hand and the large ones on some pivoted arrangement, which may be constructed to suit the convenience of the operator.

When the collodion has set, the plates may be placed on a rack in a room having a higher temperature, and allowed to dry.

Before the plates are ready to receive the exposed carbon tissue, they are given a substratum, for the purpose of making the carbon film firmly adhere to the dry collodion.

Soak and dissolve in the usual way, 1 oz. hard gelatine in 16 oz. of water; then add 25 grains of chrome alum dissolved in 2 oz. of hot water. Add the alum gradually and shake or stir well; should the solution become ropy, add a few drops of acetic acid to restore fluidity. Filter and apply with a brush or soft sponge. Should any air-bells arise take a strip of tissue paper and pass it over the surface, which will either break or bring them to one side.

Another splendid substratum is made of the following: Pure rubber, 1 dram; pure benzine, 1 pint. Filter before use, and flow over the plate like varnish.

To prepare the plates with this substratum, may seem somewhat lengthy and tedious; but in reality it does not take as much time, providing everything is conveniently arranged to do the work as it does to give a clear description of the process.

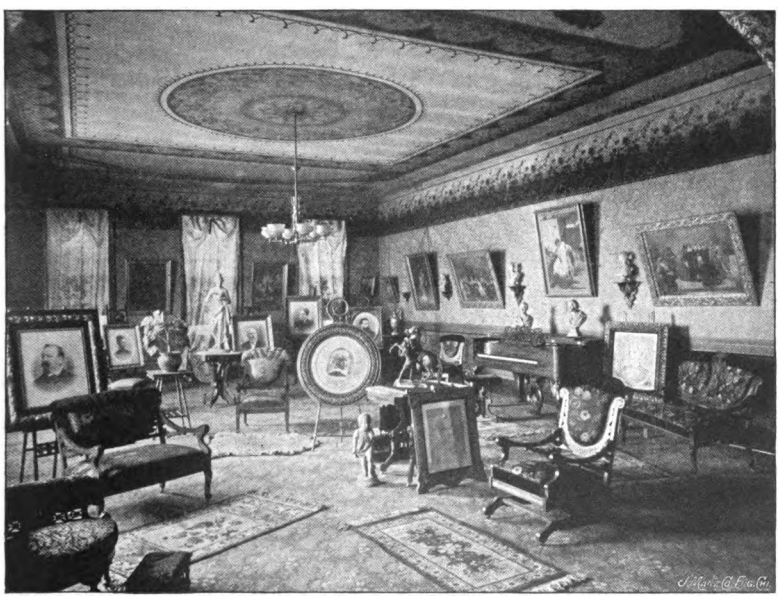
Plates prepared in this manner are easily handled, hold the film well during development, and may be prepared and kept in stock ready for use.

The following is another very simple and easy method of making double transfers. Perfectly clean glass or opal plates are well rubbed over with talc or French chalk, and then given an edge of insoluble gelatin (first wipe away an edge as above with alcohol) and then coated with the following insoluble gelatin substratum.

Gelatine (hard) 2 drams; water, 16 ounces; soak for an hour and dissolve by gentle heat, then add enough of the alkalin bichromate bath to give it a nice sherry color. Filter, and flow the prepared plates with this solution; drain off the surplus and place on a level stand until the gelatine has set; when dry expose them to a strong light for 5 or 10 minutes to render the film insoluble and the plates are ready for use. Instead of talc, waxing solution may be used, if

preferable. This makes a most perfect substratum, and is cheap, besides giving the very best results.

It is a well known fact that an insoluble gelatine substratum holds the details better than any other surface, and if the waxed surface of the temporary support has been treated to a 5 per cent solution of chrome alum, the final transfer will take place with ease and dispatch.



CHAPTER XIII.

TRANSFER TO DRY COLLODION PLATES.

ORDINARY glass plates coated with a 2 per cent collodion and dried, will give fine results and do not require the careful handling of a collodion film in a moist state. Just before making the transfer, immerse the plates in clean, cold water for at least ten minutes, to allow the film to absorb enough water to make it pliable. In making the transfer, the tissue is allowed to swell in cold water (50° F.) as usual, and when it flattens out take a plate and slip it, film side up, under the tissue, and bringing it in contact therewith, carefully lift it out of the water and place it upon the squeegee board. A thorough application of the squeegee is necessary to expel all the water and air from between the collodion and gelatine films and to form an absolute contact, otherwise the picture will be marred by the presence of little shiny specks on the face of the picture, which, being beneath the collodion film, cannot be removed.

Carefully dry the back of the tissue, especially around the margin, with a soft towel, sponge, or blotting paper; also the glass side of the plate, and place between clean, dry blotters, one over the other, until they are ready for development. Allow the transfer to rest at least twenty minutes, or longer will do no harm, providing it is kept moist and cool, or has been placed in cold water.

The developing manipulations are exactly the same as those given for single transfer pictures on opal glass or porcelain. The carbon film adheres well to a collodion sur-

face prepared in this manner, develops quickly and with less trouble than any other support of similar nature.

If the tissue was in fairly good condition and the exposure approximately correct, the pictures will develop without the least difficulty, showing all the finest details in the lights, with transparent, velvety shadows.

But, should the tissue be old and partly insoluble, or probably the exposure a little too prolonged, the development will then proceed with difficulty, and the pictures will appear dark, with veiled lights and heavily loaded shadows.

On the other hand, should the exposure prove insufficient to produce a good, strong print, especially when the tissue is known to be in good condition and probably a little fresh, the development must take place with great care, or else the pigmented gelatine will dissolve away too quickly and leave a chalky black and white picture, devoid of all half-tones and with very abrupt shadows. It will thus plainly be seen that the greater part of success in carbon printing, depends upon the care exercised in exposing the tissue to light under the negative. With a good tissue a proper exposure will always give successful results.

There is aconsiderable latitude in developing carbon pictures, which a printer, having a little skill and judgment can easily take advantage of.

By increasing or modifying the temperature of the developing bath, an over, or under exposed tissue can easily be developed with good results.

Or, if that does not produce the desired results, an addition of a little saturated solution of chloride of lime, in case of over-exposure, will probably have the desired effect. Should that fail, however, use carbon reducine, which, if used with good judgment, will clear the darkest print. From the above it will be seen that a successful development of

carbon pictures depends greatly upon the state of solubility the tissue happens to be in at the time of exposure and the time allowed to elapse before development takes place.

As soon as the pictures have passed through the alum or hardening solution, and have been well washed in several changes of cold water they are ready to be transferred to the final support, which may take place at once if so desired; but, it is not advisable, since the pictures will be greatly improved by allowing them to become thoroughly dry before making the transfer.

The image will be much sharper and will have gained considerably for the better in appearance. At the same time the pictures are less liable to prove a failure than if transferred while in a wet state.

Carbon pictures usully dry down a little darker than they appear while in a wet state. A slight allowance should therefore be made on that account, while printing the tissue as well as in the development.

CHAPTER XIV.

THE WET PROCESS.

THE following method is used by most carbon printers of the old school; and is, probably, as reliable as any, but is just a little more complicated; it requires great care in all the manipulations, to obtain successful results.

The polished glass or opal plates are cleaned and waxed in the usual way; but do not need an insoluble edge, like those prepared for the previous method.

Coat the plates with plain collodion.

Alcohol	8 ounces
Ether	8 ounces
Gun cotton	130 grains

Soak the cotton in the alcohol for ten minutes previous to adding the ether. Add the ether and shake until dissolved. For immediate use, the collodion must be filtered, otherwise, allow it to settle and decant the clear liquid for use.

Before coating, remove every particle of dust from the surface of the plates with a good camel's hair brush, and coat them in the usual way. Pour the collodion on, in one steady stream, but not all onto one spot. The ether in the collodion would dissolve away the wax, and the collodion film would become firmly attached to the glass when dry, and thus make it very difficult, if not impossible, to make the final transfer; therefore, in pouring on the collodion, hold the bottle near to the plate and pour it in a semi-circle.

When the collodion has set, which will take but a minute or two, according to temperature, immerse the plates in a tray or tank of clean, filtered water at about 50° F., and let

it remain for at least fifteen or twenty minutes. This is done to free the film of the solvents contained in the collodion, and to keep it in an unchanged or moist condition. When there are a number of plates to prepare, a grooved vertical tank such as the rubber hypo-bath holders, or a reservoir made after that fashion (figure 31) will be found handy and convenient.

Before making the transfer, rinse the plates in well-filtered, cold water, to remove all traces of alcohol, and what sediment might have collected on the surface of the film.

TRANSFERRING OR MOUNTING THE TISSUE FOR DEVELOPMENT

Arrange the tanks or trays in convenient order and fill the first one with cold water at a temperature not above 60° F., and in summer the results will be much better if it is still lower. This can easily be done by using ice.

Then pull down the yellow curtain or subdue the light, and taking the tissue from the box, brush it on both sides with a camel's hair duster, to remove every particle of dust adhering thereto.

Now immerse it face down, with as little splash as possible, and quickly remove all the air-bells and froth which gathers on the back of the paper, with a large, flat camel's hair brush or soft sponge. Then turn it over carefully, keeping it under water, and gently pass the brush over the face of the film, and again turn it face down, always keeping it under water while turning. Just before it begins to straighten out, take a plate from the reservoir and after dashing some filtered water over it to remove all traces of alcohol, lay it face up in a convenient position upon the table, or squeegee board, then before the tissue has a chance to turn backward, remove it from the water; by taking hold of the corners diagonally opposite, bend it so as to allow the diagonal line

to touch first, and without draining, carefully place it upon the collodion film as near in the right position as possible.

Should the tissue attach itself firmly to the collodion film before it has its proper position on the plate the best way to proceed then, is to again immerse it in the water and carefully lift it from the plate. Then again place it upon the collodion film, as near the correct position as possible.

After the tissue once lies flat, it firmly adheres to the collodion film, and it is not very safe to pull or drag it into position. The collodion film being very tender, it is easily ruptured. Lifting it off and replacing it is the quickest and safest way to proceed. Care should also be taken not to injure the collodion film that protrudes around the margin of the tissue, and extends to the edge of the plate.

This can best be done by using a well waxed sheet of thin celluloid instead of a rubber cloth when squeegeeing the tissue to the plate. The celluloid lies smoothly over the back of the tissue and is not liable to be dragged into ridges or creased by the squeegee. Be very careful at the beginning; stroke gently from center to sides, and when the water and air has been well expelled use a little more pressure and give it a good, careful rounding up. When, on removing the celluloid, there are no ridges or raised places visible, which would indicate the presence of air between the tissue and collodion film, the transfer may be considered successfully done.

Be sure to remove all superfluous moisture around the edges of the tissue, or else it will have a tendency to wash up or frill, and will not adhere properly during development. Cover the mounted tissue with a clean, dry blotter, and over it place a sheet of glass to keep it pressed down until another transfer has been made. This done, remove the sheet of glass and place this over the other (providing it is of the

same size) and proceed in like manner until all the exposed tissue has been transferred. As soon as the first transfer has been under pressure for about twenty minutes or a half hour, the developing operations may be commenced by placing the plates and transferred prints in cold water.

The development proper is carried on in exactly the same manner as in the single transfer process, with the exception that it requires greater care in the developing manipulations to keep from rupturing the collodion film. The image clears up very rapidly and is much easier developed than a single transfer picture. If the film on the first plate shows any tendency of washing up at the edges or leaving the plate, allow the rest to remain under pressure for at least an hour, and if necessary, still longer will do not harm, providing the back of the tissue is covered and kept moist and cool.

The meaning of weighting down or using pressure should not be misunderstood. All the weight or pressure necessary is just enough to keep the edges of the tissue from curling back or a medium pressure. Heavy pressure causes dark spots, patchy prints, and an uneven development; and is otherwise injurious. When developed, the pictures are rinsed in clean, cold water, and placed into the alum bath for about five minutes. Wash well in clean water for twenty minutes or half hour, then take a tuft of filtering cotton or a soft brush and under a tap of filtered water carefully remove all the sediment and place on a rack to dry.

CHAPTER XV.

THE FINAL TRANSFER FROM A FLEXIBLE SUPPORT.

IT IS not usually customary to transfer carbon or pigment pictures to their final supports before they have first become thoroughly dry. But, if desired, the final transfer may take place at once; after the prints have been well rinsed in clear, cold water and the last traces of bichromate as well as alum eliminated. The only advantage gained in making an immediate transfer, however, is merely a saving of time; otherwise the pictures are greatly improved by allowing them to dry before being transferred.

In drying, the print looses its relief, and at the same time the film goes over into a state of total insolubility, thus making the picture sharp and crisp, and otherwise greatly improving its appearance.

Another advantage in allowing the print to become dry upon the transitory support is, that the film being in a hardened state, it is less liable to be injured during the transfer manipulations, and consequently gives uniformly good results.

For a beginner it is advisable to follow the latter course, but, should it be desirable to make the transfer immediately after development, a soft squeegee must be used and applied with gentle pressure.

Of the intermediate supports available for double transfer printing, the flexible paper support is probably the most useful of all.

From it, carbon pictures may be transferred to almost any kind of surface, such as paper, celluloid, porcelain,

opal glass, ivory, wood, canvas, metal, etc., providing the ground is light and has been prepared with an insoluble substratum.

MANNER OF PREPARING THE SURFACE OF FINAL SUPPORTS FOR DOUBLE TRANSFER PICTURES.

The following chrom-gelatine substratum is especially recommended for celluloid or porcelain:

Gelatine	1 ounce
Water	16 ounces
Chrome alum	20 grains

Soak the gelatine in cold water for an hour and dissolve in a water bath. Then dissolve the chrome alum in a little hot water and add it to the gelatine, and thoroughly mix.

The opal or celluloid must be perfectly clean and dry. Flow over the warm gelatine without creating any air bubbles if possible, and place it upon a level stand or table.

The print resting upon the flexible support, having previously been soaked in cold water, is then well drained and placed upon the celluloid or opal plate, and squeegeed into intimate contact therewith and allowed to become perfectly dry. Celluloid or porcelain may also be coated with a substratum of bichromated albumen, and dried. When ready to make the transfer, soak the print resting upon the flexible support, in cold water until limp, and then bring it into intimate contact with the albumenized surface of the support. When dry, the picture will firmly adhere to the rigid support, and allow the temporary support to be stripped with ease.

There are quite a variety of commercial final supports on the market now. Thin, medium or heavy, smooth or rough, tinted or plain, to suit every purpose.

The final support commonly used, is a paper coated with

a partially insoluble gelatine substratum, incorporated with sulphate of baryta and a little ultramarine blue to give it a pearly tint. This support may be prepared in the studio after the following manner. Take—

Gelatine (hard)	2½ ounces
Sulphate of baryta	1¼ ounces
Chrome alum	18 grains
Water (distilled)	16 ounces

Allow the gelatine to soak in cold water as usual and dissolve in a water bath by gentle heat.

Stir in the baryta and mix thoroughly; then dissolve the chrome alum in a little hot water and add it to the mixture, a little at a time, and stir well.

To coat the paper, roll it up tightly, with the face or smooth side out, then place it upon the solution and gradually unroll it by drawing it, without stopping, from the solution, after the manner illustrated in a previous chapter. When coated, hang up and allow it to become perfectly dry before using.

A splendid final support may be made by floating a good quality of baryta coated paper, such as is used for coating with gelatine or collodion emulsion to make aristo paper, upon a gealtine solution, leaving out the baryta.

Gelatine (medium)	1½ ounces
Water	10 ounces
Chrome alum	15 grains

Prepare as previously given and coat the paper in like manner. This makes a good and cheap support and is easily prepared.

To prepare drawing paper for use as a final support coat it with the following solution:

Gelatine (hard)	1 ounce
Water	12 ounces

After the gelatine has been well water-soaked dissolve

it by gentle heat as previously directed, then dissolve 12 grains of chrome alum in 2 oz. of hot water and add it slowly to the gelatine. Apply the solution, warm, with a clean sponge or camel's hair brush and hang the paper up to dry in a room free from dust. When dry give it another application and taking a print from the cold water tray, place it upon the prepared support and bring it into contact with enough force to expel all the air and superfluous solution. Allow it to become thoroughly dry before attempting to separate the picture from the provisional support.

In transferring carbon pictures to wood or any other porous support, the pores must first be filled with some good enamel, and then coated with an insoluble substratum.

A print transferred from ground glass or matt opal will have a fine matt surface, and those from a flexible support will have a surface resembling that of an albumen print. As a basis for water color painting, or crayon work, these pictures are greatly superior to those made by any other process. First, on account of being absolutely unchangeable, and then, on account of the many different shades of pigment tissue at command, from which it is possible to obtain prints in almost any tone, and will harmonize with the colors to be employed in painting; which must be considered quite an advantage. Prints to be used for water color painting ought to be fixed or hardened in chrome alum or the alum and sulphite bath, given on page 140.

The final supports furnished by the different manufacturers of carbon tissue are usually of an excellent quality, and give the best of satisfaction.

Although there is no perceptible difference in the final result, each make of paper requires a somewhat different treatment, to obtain the same results.

The final support made by English manufacturers is allowed to remain in cold water for a half hour, or an hour, when it is ready for use; or if in winter, immerse in warm water for just a moment or two, and then place it upon the carbon print, which had first been allowed to absorb cold water for just a few moments, and is then brought in contact by a gentle application of the squeegee.

The other makes are immersed in water at about 115° F., and at the expiration of about two or three minutes, the surface of the paper becomes covered with a froth or little air-bells. As soon as the froth appears, the paper must immediately be withdrawn from the water and placed upon the carbon print, which had previously been soaked in cold water for a few seconds; cover it with a sheet of celluloid or rubber cloth, and squeegee into contact with a gentle application of the squeegee.

To make the transfer upon self-prepared paper, immerse the support in water at about 104° F. until the little air-bells appear. Then place it upon the carbon print, which has at the same time been allowed to absorb cold water, squeegee into contact and hang up to dry.

If the final support is immersed in water too hot, the gelatine surface will dissolve entirely, and if brought in contact with a print, it will not adhere thereto. On the other hand, it sometimes happens that a support gets too old and the gelatine surface becomes insoluble and will not soften even in very hot water.

Such a support is worthless and should be thrown away. It is always a good plan to first test the paper, to ascertain the state of solubility it is in, before attempting to transfer or make use of it. The final support is cut a little larger than the print, and a trifle smaller than the temporary support.

CHAPTER XVI.

FINAL TRANSFER FROM GLASS OR OPAL PLATES.

WHEN ready to make the transfer, immerse the pieces of final support which have been previously cut to the proper sizes, in clean, cold water for at least thirty minutes; but an hour will not have an injurious effect, providing the water is pure and contains no foreign matter, such as iron, calcium, etc.

When all the arrangements for making the transfer have been made, immerse a plate bearing a carbon print in tepid water for just a moment or two, and then lay it down upon a table or the flat level surface of a squeegee board. A piece of final support of a suitable size is then taken from the tank and immersed in warm water, for just a few seconds, to soften the gelatine, and is then carefully placed upon the picture. It is then covered with a thin sheet of celluloid or rubber cloth and brought into intimate contact by a gentle application of the squeegee. If a transparent glass had been used for a temporary support, it can readily be seen, by examining the plate on glass side, whether the film and support is in absolute contact or not. If the surface shows little shiny specks or patches, it is evident that air has been imprisoned between the film and support and must be removed by a little firmer application of the squeegee.

When the final transfer has been successfully made, place the plate upon a drying rack and let remain about an hour, after which it is placed between clean dry blotters and allowed to become perfectly dry, which, according to tempera-

ture, requires from four to six hours. Avoid placing the rack into a strong current of air, especially in hot weather. The prints dry from margin to center and unless the proper precautions have been taken to prevent it, the edges of the picture will curl up as it gradually becomes dry, and a streaky and uneven surface will be the result. A good way to prevent the edges from curling up is to paste a second piece of final support over the first and have it large enough to lap over and paste it onto the back of the glass; or, to attach thin, narrow strips of wood by means of photo clips, to two sides of the print, that will effectually prevent the print from leaving the support before it is thoroughly dry. When dry, the picture will strip with a uniformly even and smooth surface, either glossy or matt, whatever the nature of the temporary support employed may be.

Do not attempt to separate the print from the support until it is perfectly dry. Any attempt before that would prove fatal to the picture. In fact, it would be impossible to remove it, without tearing the print all to pieces.

As soon as the picture has become thoroughly dry, pass the point of a knife all around the edge and peel it from the support. The picture now resting on its final support, if transferred from matt opal, will have a beautiful matt surface, which for artistic appearance, cannot be equaled by any other process. If the picture rests upon a collodion film, cut it through to the glass and pass the point of a knife under one corner of the print and peel it diagonally. The print will come off with a clean margin and an exquisitely brilliant surface.

Should the pictures refuse to leave the support, however, or adhere to it in spots, especially in the high lights, when attempting to separate them from the support, it is plainly evident that the plates used for temporary supports were

not perfectly clean, and the waxing had been improperly done. Too vigorous rubbing when polishing will remove too much or all of the wax from the plates, and will cause the print to adhere firmly to the glass, from which it will be almost impossible to remove it without injury. About the only safe remedy, when such difficulties arise, is to heat the plate; which in most cases, will have the desired effect. This trouble only occurs with polished, collodionized plates, however, and hardly ever with opal or ground glass.

Pictures developed on opal or ground glass may be transferred to almost any kind of flexible support in the following manner:

Make a three per cent solution of gelatine and filter through fine muslin: Use at about 80° F.

The pictures resting upon temporary supports are coated with the gelatine solution, and placed upon a level surface, and the gelatine allowed to set; after which they may be stood on edge in a medium cool room free from dust and allowed to rest about an hour.

The gelatine now being quite firm, moisten a piece of support of whatever nature it may be, to expand it, and then place it upon the gelatine-coated print and bring into intimate contact therewith by gently applying the squeegee. The paper will adhere firmly to the print, which when dry, may be readily stripped from the support.

DOUBLE TRANSFER PICTURES ON CELLULOID OR OPAL GLASS.

Carbon pictures upon celluloid or opal glass are somewhat difficult to make, and with the inexperienced, failures are numerous and discouraging.

The main difficulty that most printers complain of, is refusal of the print to leave the support without loss of the fine details in the high-lights and half-tones of the picture,

caused by the print becoming firmly attached to the temporary support on those parts.

To avoid this trouble is simple enough, if the following mode of procedure be adopted:

Wax the temporary support well, and after polishing immerse it in a 6 per cent solution of well-filtered chrome alum, for about five minutes and let dry. The details will never stick to a support prepared in this manner, and the prints will strip clear and clean, without the least difficulty.

Another very simple method for making double transfer pictures upon celluloid or porcelain, is to polish a sheet of smooth, single transfer paper with talc and then coat it with a 10 per cent solution of bichromated albumen.

To 1, oz. of fresh egg albumen, add 10, ozs. of water, and enough alkaline bichromate solution to give it a strong yellow color. Shake well and filter through cotton, then let stand at least 24 hours. Coat the prepared surface of the single transfer paper with this solution, and when dry, expose it to a good strong light, for at least ten minutes to harden the film.

This albumen substratum will hold the most delicate details and the picture will strip without a flaw, presenting a very fine surface.

The celluloid or opal glass must of course, be previously coated with chrome gelatine.

Gelatine	1 ounce
Water	16 ounces
Chrome alum	15 grains

Allow the transfer to dry for about an hour, and then lay it face-down flat upon a double thickness of heavy blotting paper, and let remain undisturbed until perfectly dry; when the paper will readily strip, leaving the print firmly attached to the support of celluloid or opal glass.

CHAPTER XVII.

MOUNTING AND FINISHING—THE CARD MOUNTS.

NEVER in the history of photography, has the market been flooded with such a profusion of cards and mounts of every description, as at the present time.

There are plain cards, book deckel and art folders, in an endless variety of beautiful and artistic designs; of which the art folders are by far the best and most suitable mounts for carbon pictures, ever introduced.

The soft, mellow tints in which they are obtainable, harmonize beautifully with the tone or color of the picture, and by exercising good taste and a little judgment, perfect harmony in color and design is obtainable; an advantage never offered a carbon printer heretofore.

Aside from the great variety of art folders, there are the platinotype cards; an elegant mount with plate sunken center and india tint, most suitable for large work, and probably the best mount obtainable for that class of pictures. Of course, for people of good taste, and those possessing a little skill and artistic ability, there is no end to producing hand-made mounts and folders; which may be tastefully decorated to harmonize with the design and color, as well as the subject of the picture. Plain, ordinary and inappropriate mounts, instead of adding to the effect, detract from an otherwise beautiful picture, and make it common in appearance. While on the other hand, a well selected, tasty mount, will heighten the effect, and add to the beauty and charm of the picture. The latest innovation are beautiful cases and boxes, that are especially suitable for carbon pictures upon porcelain, etc.

MOUNTING THE PRINTS.

The mounting and finishing of carbon pictures, whether single or double transfer, does not differ materially from that of finishing aristo or platinum prints.

Any good mountant of the non-cockling variety may be employed. Greater care must, however, be exercised in applying the paste, so that it does not get on to the face of the print, and especially if it be in the nature of a cement.

If, by accident, any of the paste should get onto the surface of the picture, carefully remove it as soon as possible with a wet sponge.

The print, if in a wet state, is placed upon a clean slab or plate of glass, and the paste applied in the usual manner. Unless the prints have been thoroughly hardened in the sulphite and alum bath, great care must be exercised in handling them, when in a wet state. The soft and spongy film is very easily injured while in that condition, although it is very tough and hard when dry.

The safest and best way, although it consumes considerably more time, is to allow the pictures to become perfectly dry, and then, placing them face down upon a clean paper, apply the paste very carefully to the back of the print.

Large pictures, especially, should be mounted in that way.

Paper prints, well hardened in sulphite of soda and alum, if allowed to become dry, are re-wetted, and stacked up, one over the other, and the paste applied the same as on aristo prints. The care, which must necessarily be exercised in selecting or making a mountant for silver prints, is not necessary for carbon pictures.

The body of the picture, as well as its tone or color, being

a pigment, is not decomposed by the paste. The only injurious effect a poor paste would have upon the picture, would be to turn the support yellow in time; but the image, or picture proper, would not be effected.

Double mounting carbon pictures on paper is another good method; wet the prints and then squeegee them down upon a waxed plate, either ground or plain. At the same time, immerse some single transfer paper, which, when fully expanded is mounted, gelatine side out, upon the prints, resting on the ground glass. When perfectly dry, the pictures will strip from the glass with a fine surface and will not curl. Trim and mount, by tacking them at the corners like platinotypes.

Pictures developed upon celluloid should be mounted with LePage's glue, or a paste containing a quantity of glue.

SPOTTING OUT BLEMISHES.

Spotting double transfer pictures developed upon a collodion film must be done before making the final transfer.

Prints mounted upon opal, ground glass, or paper supports are best spotted out after the transfer. Rub the face of the print with a flannel tuft dipped in alcohol to remove all traces of wax; the color will work easier and adhere better. Any good spotting colors, either oil or water colors, may be used for this purpose. A piece of unsensitized tissue, the same color of the print, dipped in warm water, will answer the purpose better than any other medium that could be employed. If water colors are used, a dilution of purified ox gall in alcohol must be applied, and if oil colors are used, then first apply a solution of isinglass.

Isinglass..... .....100 grs.
Water..... ....6 oz.

SURFACING THE PRINTS.

Soak for two hours and dissolve. Then add 6 oz. of alcohol.

Although the matt surface of the carbon print is considered very artistic and is greatly admired, there are a great many who like to see full detail all over the picture or at least an indication of gloss.

A semi-gloss may be obtained in the following manner. After development rinse the picture well and drain, then flow with:

Hard gelatine..... ..... 1 oz.
Formalin .... 1 dram
(or as much as the gelatine will stand without precipitating.)
Water..... ....10 oz.

This will give the picture a protective coating, and will show up the definition better in the shadows.

The following mixture will also answer the purpose admirably, and will at the same time serve as a protection for the print:

No. 1. White wax.....1 ounce
Gum elemi..... .....1 dram
Oil of lavender..... .....1 ounce
Rectified benzine..... .....10 ounces

Apply by rubbing over the surface of the print with a flannel tuft. Or,

No. 2. White wax.....6 ounces
Mastic..... ....3-4 ounce
Rectified turpentine..... .....25 ounces

Apply with a flannel tuft.

ENAMELING CARBON PRINTS.

Pigment pictures with a brilliant glossy surface, may be produced by squeegeeing the finished carbon print to a pre-

pared glass or ferrotype plate; or, it may be enameled in the usual way.

Polish the surface of a perfectly clean glass plate with talc or French chalk, and coat it with a 1 per cent enamel collodion and let dry.

Then make a plain solution of gelatine (hard) 1 oz., water 16 oz., dissolved in the usual way. When ready for work, take a collodionized plate and pour a little of the gelatine upon it and at the same time cover or immerse the print into the gelatine, and lay it upon the prepared plate, then with the squeegee, remove all the superfluous solution and bring it into intimate contact with the glass.

When dry, the picture will strip from the glass with an exquisitely brilliant surface.

Enameled carbon pictures are very beautiful and have merits of their own. The high gloss of the collodion surface, gives the true depth of tone and vigor of the print, with all the delicacy and wealth of detail; which is partly lost in the matt or sunken-in surface of an ordinary carbon print.

IMITATION OF BURNT-IN ENAMELS.

Carbon pictures, transferred to porcelain, china, opal glass, or any other suitable support, may be made to appear like burnt-in enamels, by coating them with Amber or Copal varnish, and then heating them to 150°, or 190° F., for several hours in an oven and slowly letting them cool. This operation, if repeated several times, makes a most perfect imitation. Instead of heating, the varnished surface may be treated with finely powdered pumice stone, and afterwards rubbed with tripoli and oil, and finally polished with chalk. If well done, this method produces most beautiful results, pictures that can hardly be distinguished from the real burnt-in enamels.

CHAPTER XVIII.

CARBON PICTURES UPON IVORY AND IMITATION OPAL SUPPORT.

IVORY is very easily affected with bichromate and other chemicals used in the carbon process. Therefore, it is impossible to develop carbon pictures directly upon a support of that nature. The double transfer process, however, enables us to overcome this difficulty by first developing the picture upon a flexible temporary support of paper, and then transferring it to the ivory in similar manner employed for opal or porcelain. The ivory tablets used for the purpose should be well cleaned, and must be as free from scratches and blemishes as possible. Should there be any scratches, however, carefully remove them with cuttle fish powder and clean water, rubbed over with a fine cork. When finished rinse in distilled water and dry with clean soft linen.

Immerse the ivory into the warm gelatine solution, (gelatine ½ oz.; alum 10 gr., water 10 ozs.) face up, and then introduce the picture resting upon the flexible support, face down and bring the film and ivory into contact beneath the surface of the solution; then remove the ivory and adhering print to the squeegee board, and carefully bring them into intimate contact by gently applying the squeegee.

Set aside until perfectly dry and then peel the paper support from the plaque, leaving the picture firmly adhering to the ivory support; which has remained clean and untarnished. A little mythelated spirit applied to the surface of the print with a soft sponge or flannel, will remove all traces

of wax. The picture is then ready for treatment by any desired process.

CARBON PICTURES ON METAL PLATES—THE MODERN DAGUERREOTYPE.

A carbon picture printed from a negative having a light ground, when transferred to a polished silver plate greatly resembles a daguerreotype. This picture, has been introduced as the modern daguerreotype, and bids fair to become one of the fads in picture making. The picture, resting upon a flexible support, is covered with an insoluble gelatine by means of a soft camels-hair brush, and is then placed upon the metal plate and squeegeed in contact.

When the picture has become perfectly dry, the intermediate support will peel off very readily, leaving the picture firmly resting upon the metal plate.

With a gold bronze matt, and neatly framed in a plush frame, these pictures present a very rich appearance, and, furthermore, command a very respectable price.

Carbon pictures upon matt aluminum, present a rather striking appearance, especially when printed in purple, brown, or sepia pigments. The deposit should be rather light and transparent. A light back-ground, and light drapery, usually give the best results.

IMITATION OPAL SUPPORT.

Before the introduction of matt surface celluloid, as a support for carbon pictures, some of the leading carbon printers made pictures upon a support which closely resembled the opal, and the now very popular carbon picture on celluloid.

These pictures were very beautiful and not at all difficult to make, and brought a good profit to those who become proficient in their production.

The manner of proceeding is simply as follows:

Take any picture that has been developed on a rigid temporary support; which had previously been waxed, such as opal or plain glass plates, and brush it over with a thin coating of isinglass, and allow it to dry. Then spot it, or tint and color it, in any way to improve its appearance, and coat it with collodion prepared after the following formula:

Ether	15 ounces
Alcohol	14 ounces
Gun Cotton	1 ounce

Soak the cotton in the alcohol for about ten minutes, and then add the ether, and shake it until dissolved. Then take a small bottle of Windsor & Newton's water-ground zinc white, and dissolve it in one ounce of alcohol and add it to the collodion, a little at a time, shaking it well at each addition. Any color, such as carmine or ultramarine may be added to give it a tint.

Flow the collodion to completely cover the whole picture and let it remain at rest until perfectly dry, which will require a least an hour in a good, dry atmosphere. Then paste a layer of heavy, tough paper over the back to support the film, and when perfectly dry, strip the print from the glass and trim and mount in the usual way.

CARBON PICTURES WITHOUT TRANSFER.

The latest improvement in carbon printing is claimed by D'Archy Power, M. D., of San Francisco.

His discovery (?) consists in coating a thin film of either smooth or matt celluloid with a pigment compound, and then sensitizing the same, as he would carbon paper.

The safe edge may be dispensed with, and the exposure is made through the celluloid film in the usual way, which leaves the back of the pigment film unaltered, and all that is necessary after exposure, is to proceed with the development. The transfer and the intervening 10 or 20 minutes under pressure are not required, and the development may take place at once.

If the pigmented celluloid film is not procurable, the ordinary carbon tissue may be sensitized in the usual way and squeegeed to a thin sheet of celluloid film. For this method a safe edge will be necessary and it also requires the extra work of removing the paper support from the back of the tissue; otherwise the work is the same.

After the print has been hardened and washed, a piece of final support or any other suitable paper may be mounted on the back of the picture, or it may be tinted or painted, as may be desired. The picture is, of course, non-reversed.

Dr. Power communicated his experience to the various photographic journals, and seems to put a high estimate upon the results of his discovery.

About eight or ten years ago, I experimented on exactly these same lines, but my experience was quite different. I found that the celluloid, no matter how thin it was, destroyed the purity of the whites, as well as brilliancy of tone, or color in general; and, compared with good single or double transfer pictures, they had a very cheap appearance, especially after the celluloid had become a little rubbed.

Being satisfied of the impracticability of this method from an artistic point of view, I abandoned it, like probably a great many others have done before me.

Since then I have noticed, that at intervals of every few years, someone stumbles onto this same idea.

In 1898 Mr. Ernest Human, a prominent carbon printer of London, hit upon the idea and had about the same experience I had with it. It had never been mentioned by the photographic press until brought into prominence by Dr. Powers' experience.

Not until a perfectly colorless film of celluloid is obtainable, will it be possible to obtain satisfactory results by this method.

PIGMENT PICTURES ON CANVAS AS A BASIS FOR PAINTINGS IN OIL COLORS.

Pigment pictures on canvas make an almost perfect basis for pictures to be finished in oil colors. The many shades of tissue to select from, make it possible to produce a print that will be in perfect harmony with the colors of the painter's palette, and are in every respect as permanent; and in some instances, much more so. Transferring pigment pictures to canvas as a basis for oil painting is done only in the larger sizes, as a rule. The smaller sizes are mounted upon supports such as ivory, celluloid, wood tablets, etc. These pictures are, of course, made by double transfer; the print being first developed on a flexible support and then transferred to canvas, etc.

The surface of the final support, of whatever nature it may be, must be prepared with a substratum of insoluble gelatine that will receive the print and permanently hold it in absolute contact therewith.

Before applying the insoluble substratum to the surface of ordinary canvas, it must be well scoured with soap and brush. This must be done with great care, however, in order not to lay the canvas bare. After scouring, allow the surface to become thoroughly dry, and then coat with the following substratum:

Gelatine (hard)..... .... 1 ounce
Water..... ....12 ounces

Dissolve in the usual manner, and add 30 grains of chrome alum dissolved in a little hot water, a little at a time, or one dram of formalin, and stir well.

The warm solution is spread over the prepared surface as evenly as possible, with a sponge or brush, and allowed to become perfectly dry before another is applied.

Before applying the solution for the third time, immerse the print resting upon the flexible support in cold water, and then apply another good even coating of the insoluble gelatine to the canvas. This done, take the print from the water and carefully place it in position upon the canvas, and bring it into intimate contact with a soft rubber squeegee. It must then be left undisturbed until it is perfectly dry, when the support readily separates, leaving the print resting firmly upon the canvas. After receiving a substratum of isinglass it is ready for the brush of the artist.

There is a commercial canvas, grained single transfer support obtainable, that makes a splendid imitation of canvas. This may be mounted on cardboard or muslin, and makes a fine substitute for the real thing.

The print, which is usually in Sepia or Standard Brown, (Sepia for a blond and brown for brunettes), is first well coated with a solution of hard gelatine or isinglass, and is then ready to paint upon.

Part IV.

CHAPTER I.

CARBON POSITIVES ON GLASS—PRELIMINARY REMARKS.

THE value of carbon positives is becoming more and more apparent, as the process finds it application in the different branches of photography. Carbon transparencies are important factors in the reproduction of reversed negatives for single transfer printing, and as a medium for the reproduction of enlarged negatives. For the latter purpose especially, no other process can in any way equal or render such splendid and almost perfect results.

The solar negatives made by this process will surpass in delicacy and fineness, all other negatives made for the purpose.

The carbon lantern slide possesses the most perfect gradations from clear glass to the utmost opacity, which, when projected upon the screen, produces pictures with fine relief and brilliant and beautiful effects.

In no other process, can the skillful printer find such a wide scope in which to exercise his artistic ability, as in the production of carbon window transparencies, both in monochrome and color.

It will very readily be seen that the positives made by this process may be put to very profitable use, and the cost of its

production is much below, or at least not exceeding, that of those made by any other process.

For strong, brilliant transparencies, to be viewed by transmitted light, it is necessary to employ a tissue that has been especially prepared for the purpose. This tissue is charged with a greater amount of pigment or coloring matter, than is used for ordinary tissue, such as filtered India ink, or the like. For some purposes it should contain from a half to three-fourths more than the amount usually employed, in the manufacture of ordinary carbon tissue; which is necessary to yield sufficiently strong and vigorous positives, as for instance those which are used for the reproduction of carbon negatives.

The special transparency tissue supplied by the manufacturers of carbon tissue is usually of a very excellent quality and gives the most perfect results.

The production of brilliant effects, fine relief, and sparkling transparencies, for windows as well as lantern slides, require sharp, crisp negatives, full of life and vigor, and not a trace of fog. Negatives of the weak, flat order are unfit for the purpose, unless they are made sufficiently intense by redevelopment.

CHAPTER II.

THE PREPARATION OF GLASS PLATES, FOR WINDOW TRANSPARENCIES, LANTERN SLIDES AND NEGATIVES.

THE smooth surface of ordinary glass plates will not hold the carbon film in contact during the process of development, unless it be especially prepared for the purpose. Therefore, the first step toward making transparencies, etc., by the carbon process, is to prepare the surface of the glass plates upon which they are to be developed, with an insoluble substratum, that will hold the film in contact during development, and when dry, will cause it to adhere firmly to the plate.

The plate for this purpose should be flat, clear, and colorless, and as free from blemishes and imperfections as possible. The first operation is to clean them with nitric acid, caustic soda or ammonia, or any of the well-known methods in use, and then rinse them well in filtered water, and place on a clean drying rack into a cupboard or room free from dust, until dry.

While the plates are drying, prepare the following bichromated gelatine solution:

No. 1. Gelatine (hard)..... 1 ounce
Water (soft)..... .....30 ounces
Bichromate of potash.....80 grains

Allow the gelatine to soak in the water for at least an hour, and then pour off the water, and add thirty ounces of boiled rainwater.

Dissolve by gentle heat in a water bath, and add the bichromate in powdered form, which will quickly dissolve

in the warm solution, and then filter through a double thickness of fine muslin.

Keep the solution at a temperature of about 85° F., or warm enough to flow evenly. The plates must be well dusted and then flowed with the chrome-gelatine, after the manner of coating plates with varnish or colloion. A little practice will teach the beginner how to flow the solution without causing air-bells and ridges.

Put the plates into a room or cupboard where they are well protected from dust, and let them remain until perfectly dry, and then expose them to strong day-light for a few minutes, which has a hardening effect upon the gelatine and causes the substratum to become insoluble.

Plates prepared in this manner keep indefinitely, and may be kept in stock for future use.

The following method of preparing glass with an insoluble substratum is used quite extensively, although probably a trifle more difficult to prepare than the foregoing:

Gelatine (hard)	1 ounce
Water	20 ounces
Chrome alum	20 grains

Allow the gelatine to absorb as much water as it will in about one hour; then pour off the surplus and add fifteen ounces of boiled rain-water, and dissolve by gentle heat in a water bath.

Dissolve the chrome alum in the remaining five ounces of hot water, and add it to the gelatine a little at a time, by pouring it into the solution in a very thin stream, stirring the gelatine vigorously while making the addition.

Should the gelatine show any signs of thickening or becoming ropy; add acetic acid, a little at a time, and stir well until it again becomes fluid, but no more. Repeat if the addition of the remaining alum should have the same effect. Filter well before use.

This solution is applied in the same manner as the foregoing, by flowing, or with a soft brush.

A very excellent substratum is made by dissolving one dram of pure rubber in benzine. Filter, and flow over the plate in the usual way.

This makes a splendid substratum where the positives are to be tinted or colored with transparent colors, as the rubber, like collodion does not absorb the color.

The following preparation will be found excellent for plates that are wanted for immediate use:

Gelatine (hard)	2 1-2 drams
Water	7 drams
Glacial acetic acid	1 1-2 ounces
Alcohol	10 ounces

Allow the gelatine to absorb water for an hour and dissolve in a water bath. When dissolved, gradually add enough of ten per cent solution of chrome alum to thoroughly precipitate the gelatine.

Drain off the water and dissolve the precipitated gelatine in the 1½ ounces of glacial acetic acid by gentle heat, then gradually add ten ounces of common alcohol and filter. In applying this solution, warm the plate a little and flow like varnish or collodion. The plates dry out rapidly and may be used just as soon as cool. The solution keeps indefinitely in a well-corked bottle.

Another very excellent substratum may be made as follows:

Hard gelatine	4 drams
Water	.3 ounces
Glacial acetic acid	6 drams
Alcohol	20 ounces
Formalin	1 dram

Soak the gelatine and dissolve in the usual way; then add the ascetic acid and stir well, and then the alcohol, and lastly, the formalin.

CHAPTER III.

WINDOW TRANSPARENCIES IN MONOCHROME AND COLORS BY SUPERPOSITION OF VARIOUS PIGMENT TISSUES.

THESE beautiful pictures are admired by everyone, but for all that, strange as it may seem, there are only a very few photographers who make them, or at least only a few that produce a presentable transparency.

Window transparencies made by this process are very beautiful, on account of the rich coloring obtainable by this method. The special transparency tissue gives the best results, but it is not strictly necessary to employ this for all pictures. Any color may be used with good results, and if the printer possesses a little skill and patience, it is possible for him to produce pictures in several different colors, and be right in line with the popular fad of making pictures in the colors of nature. Thus, a beautiful blue sky, with white, fleecy clouds, green trees and meadows, and red or brown buildings, etc., may be printed from the same negative, in distinctly different colors, by superimposing different colored pigment tissues, one over the other and thus produce pictures that are strikingly beautiful.

Of course, pictures of this kind require considerable skill and a great deal of time, with an abundance of patience.

The ordinary transparency that is intended to be tinted or colored with transparent water colors must be developed on plates with a collodion or rubber substratum.

The three color positives require time but otherwise are not so difficult to make as might be supposed.

To begin with, mask the negative on the glass side with an opaque paper mask, having clean cut edges; leave all the parts exposed which are to be printed in one particular color. Glue the mask at the corners and place a ground glass of the same size over the whole. This will serve to press the mask down smoothly and prevent any oblique rays or reflection from reaching too far under the mask. To blend one color into another, vignette the parts so they blend softly.

Place the negative and ground glass into the lower left hand corner of the printing frame, and be very careful to place it in exactly the same position for every succeeding exposure. Each and every pigment tissue must be of exactly the same size and perfectly square and true. Each piece of tissue must be marked at top and bottom to avoid making mistakes.

When sensitizing tissue for this purpose it should be squeegeed and dried against a ferrotype or squeegee plate. Cut the pieces of tissue all to exactly the same size, and when ready to print place it square into the corner like the negative, and place all the following pieces, of whatever color they may be, in exactly the same position. This part of the printing requires strict attention in order to make all the different films register properly.

To print the next color remove the mask used for the preceding impression and mask the negative as before, leaving all the parts of some other color exposed. In this way every pigment is printed in exactly the same manner. Every color requires a different mask, and each color is produced with a different tissue.

The printing and developing manipulations are carried on in the usual way. The glass is prepared as given on page 185, and one film is superimposed over the other. Starting with the sky or blue, followed by the green, then the build-

ings, figures, rocks, etc., always bringing in the foreground last. For double transfer reverse the order and transfer the foreground first then the middle distance and lastly the sky, etc. If this is carefully done, all the films will register perfectly, so that when viewed by transmitted light, they appear as one film in so many different colors.

A simple method to make the different parts register perfectly is as follows: Cut a piece of white cardboard the exact size of the glass support upon which the picture is to be transferred. Mark in distinct lines the exact size of the tissue in its correct position, and when ready to place a film into position, place this card as square and exact under the glass as possible; then when the tissue flattens out take it by the two corners diagonally opposite and place it, very carefully, square into the lower left hand corner of the rectangle marked upon the card. Squeegee this film in contact with the glass as perfectly as possible and let it rest for the proper length of time. Develop in the usual way and immerse the print when developed in a weak solution of alum for one minute. Rinse in water at about 60° F. for a few minutes and then proceed with the next film in exactly the same manner as the one just developed, only with a little more care, especially when placing the film in position. If possible this should be done, so that when it once lies flat it does not need to be disturbed. The wet film just developed, might by pulling, be easily distorted, if not ruptured. Usually three films make quite an attractive picture, but four will be found better —say blue, green, red and brown, or sepia for landscapes.

The most practical way to proceed is to make a light print in sepia or brown of the whole picture as it is, excepting the sky, taking care not to get the shadows too dark. This print serves to give the required shading and gives the

picture a better defined and sharper appearance. Then follow with the other films as previously directed. It is best to dry a picture made in this manner slowly and in a horizontal position.

To make pictures of this kind on paper or similar supports it is best to make them by double transfer. An opal plate will answer the purpose better than any other for matt surface pictures. Cut all the pieces of carbon tissue of exactly the same size, and when the first impression has been transferred run a pointed lead pencil around the edge of the tissue; the next piece of tissue is then placed exactly within this mark, and will register perfectly, with the one just developed. Proceed in like manner with all the remaining prints. This kind of work will be found very interesting and should be given a trial by all carbon printers.

In blending the distance of a landscape into the middle distance, let the distance be printed in the sky tint and be vignetted to blend softly into the green, and the latter vignetted to blend in like manner. Use blue chalk tissue for the sky and sea green for the middle distance.

CHAPTER IV.

THE LANTERN SLIDE.

IN THIS charming branch of photography, the carbon slide will at once be recognized as greatly superior to those made by any other process. The range of tone or color at command, makes it possible to obtain almost any desired results, while the nature of the process is such that any effect, from perfectly clear glass, producing pure, brilliant whites that blend into delicate half-tones, to the utmost opacity, may be obtained without the least difficulty.

For brilliancy, fine relief and beautiful effects, the carbon slide cannot be surpassed, while the intensity of the white light usually employed for slide projection does not in the least affect it. This alone is sufficient recommendation, especially where slides are made for scientific purposes. Very often these are difficult to procure and are quite valuable; therefore, they should by all means be absolutely permanent.

Ordinary carbon tissue will give fair results, but for first-class slides it will be found necessary to prepare a tissue coated with a pigment compound containing an increased amount of very finely divided coloring matter, such as filtered india ink.

Should warmth of color be desired to produce certain effects, it is best to add color of a transparent nature, such as gamboge, madder, lakes, etc.

The special transparency tissue supplied by the different manufacturers of carbon tissue is of an olive black color and is usually of an excellent quality. It is only obtainable in

bands, however, which makes it rather expensive where there is but a small amount of work to be done.

One thing of importance is, that the transparency tissue must have a perfectly even or smooth surface, so that it can be brought into intimate contact with the negative, otherwise it would be impossible to obtain perfectly sharp positives.

To get the proper surface, the sensitized tissue, must be squeegeed against a glass, ferrotype, or hard rubber plate, and let remain until perfectly dry. After which it may be stripped and stored away in air-tight tin boxes for use.

Tissue treated in this manner will have a smooth, glass-like surface and will give perfect contact, and should be at least three or four days old to give the best results.

First-class positives require correspondingly good negatives to work from. Those that yield the best slides are perfectly sharp and crisp, full of detail, clear, clean, and of good density.

It is not necessary to reverse the negatives used for this purpose. The slide or transparency may be projected from either the film or the glass side of the plate, giving the same effect.

The exposure required for lantern slides is just a little longer than for ordinary positives on paper, but not nearly so long as for positives used to make reversed or enlarged negatives.

The glass used for first-class slides should be the best crystal glass, which is sold by all stock dealers for that purpose. Discard all imperfect plates, and select only those that are thin and perfectly flat.

In order to insure perfect contact, the glass must be well cleaned and then polished with chrome alum dissolved in

alcohol, or they may be prepared after the manner given for positives in general.

With the exception that a greater amount of care should be exercised, the developing manipulations are exactly the same as those for ordinary positives on opal glass. Making the transfer or squeegeeing the tissue to the plate, is where it is necessary to exercise the greatest care. If the tissue is stretched or drawn, as it sometimes is, it will distort the image, and the slide will be unfit to use.

When the water used for development contains grit or a good deal of organic matter, it should by all means be filtered; it makes a very marked difference in the final results.

The alum bath must be well filtered and the slides intended to be colored in oil colors should remain immersed for a considerable time longer than ordinary carbons, to thoroughly harden the film; this is strictly necessary where there is considerable brush work to do. Use the sulphite and alum hardener for that purpose. On the other hand, if it is intended to tint the slides with aniline dyes, or tone and intensify them, it is best to omit the hardener altogether, or at least use a very weak solution of alum and immerse for just a few minutes.

An indurated or thoroughly hardened film will imbibe an aqueous solution with difficulty, if it all.

As soon as the transparency has been thoroughly washed and dried, it is ready for the mask and cover glass, unless it is to be colored, which must be done first before it is mounted.

TINTING OR COLORING LANTERN SLIDES.

The best and most approved method of coloring lantern slides, is to tint them with aniline dyes. These are perfectly

transparent, show no grain and produce wonderfully brilliant color effects. Colors especially prepared for this purpose may be bought at any art store or photographic stock house. Coloring or tinting lantern slides that will give beautiful and artistic effects upon the screen, requires considerable skill, and a great deal of patient practice.

The best and most practical way for a beginner to proceed, is to color a slide by artificial light, such as is used in the lantern. When thought to be properly done, project it upon the screen and study the different effects. Then tint another and make the necessary alterations and improvements in shade and density of color, and test it as before. If this one is satisfactory it may be used for a sample and all the rest tinted by it in ordinary daylight. When the coloring has been successfully done the slide is ready to be mounted in the usual way.

Any good slide representing some place of general interest; a good subject in genre, or one illustrating a broad stretch of beautiful scenery, if colored by a skillful hand, will, when projected upon the screen, enrapture the most critical audience; where on the other hand, a poorly tinted one will receive but little or no attention.

Therefore, unless the colorist possesses some natural talent, combined with the necessary good taste, and an abundance of patience; so that after a reasonable amount of practice he is able to color a slide in a presentable manner; it is advisable for him to let a good slide alone. It will always be better appreciated than a poorly colored one.

A little practical experience will teach the lanternist the advantage and value of transparencies made by this process.

CHAPTER V.

TONING AND INTENSIFYING CARBON PICTURES AND TRANSPARENCIES.

CARBON pictures and transparencies, weak or poor in color, may be greatly improved by toning and intensification. This is done mostly by the employment of coloring matter or dyes, and reagents that act in harmony with chromic oxide.

The dyes and coloring matter, if carefully selected, and the same amount of care exercised in their preparation, as well as application, will give an even smooth deposit without showing the least sign of granularity or opacity, and may, without hesitation, be applied to the most delicate parts of the finest lantern slide or transparency. When aniline dyes are used it is well to avoid such mordants as chrome alum or tannic acid. These are apt to greatly effect the brilliancy of the tone.

Permanganate of Potash, dissolved in distilled water, and filtered, is one of the most useful toning, as well as intensifying agents we have.

The color imparted to the print or transparency is of a more or less intense olive green, according to the strength of the solution employed, and is not very pleasant to the eye; but it is very valuable for the intensification of carbon negatives and positives, to which it imparts finer printing qualities than could be obtained by any other method.

The strength of the solution varies according to the intensity and depth of color desired, from a one per cent to a

saturated solution. The following is employed for transparencies:

No. 1.	Permanganate of potash	1 part
	Distilled water	250 parts
No. 2.	Water	250 parts
	Ammonia (aqua fort)	½ part
	Sugar	½ part

Immerse the transparency in clear, cold water for a few minutes, and then apply a solution of equal parts of Nos. 1 and 2. Let remain until the desired color or intensity is obtained and then rinse thoroughly in clean water. The tone will be of a yellowish tint.

Sepia Brown.—This color is obtained by first applying a one per cent solution of permanganate of potash and afterwards immersing the print in a weak solution of pyrogallic acid.

Deep Black.—Apply, first, a one per cent solution of permanganate of potash, and then gallic acid. A weak solution of sulphide of ammonia is usually employed as a clearing agent.

Warm Brown.—Pyrogallic acid and nitrate of silver give fine warm black tones. Use hyposulphite of soda for clearing.

Dark Purple.—The following give fine results:

No. 1.	Ferric Sulphate	1 dram
	Water (distilled)	2½ oz.
No. 2.	Carbonate of Sodium	½ dram
	Water	2½ oz.
No. 3.	Gallic acid	1 dram
	Water	2½ oz.

If the chemicals dissolve tardily, apply gentle heat. These solutions keep indefinitely. Filter carefully before use. The manner of toning is to employ the solutions separ-

ately in the order given from eight to twelve minutes, rinsing after each application.

Green.—For a green tone use pyrogallic acid for No. 3 instead of gallic.

Dark Green.—A very dark green is produced by the employment of tannic acid or catechu. Both the tannin and catechu have a tanning or hardening action on the gelatine. Wash thoroughly. Should it happen that the image, in drying, has obtained a greater degree of intensity than is desired a solution of citric or oxalic acid will reduce it to any desired degree.

Red.—Bichromate of potash, when followed by a solution of nitrate of silver, gives a color similar to red chalk. Clear with hyposulphite of soda.

Carmine Red.—An ammoniacal solution of coraline, diluted in water, produces a very fine color.

Violet.—Alizarin dissolved in alcohol and diluted in lime water. A variety of tones, ranging from violet to purple may be produced by the employment of alizarin with the caustic alkalies. The intensity of color varies according to strength of solutions.

Purple.—An ammoniacal solution of alizarin with acetate of lead gives a fine purple tone.

Brown.—Ferrocyanate of potash with chloride of nickel make a very fine brown tone.

Warm Sepia.—Nitrate of uranium with potassium ferrocyanide, produce a splendid warm sepia.

Green.—Extract of indigo and bichromate of potash produce a green that is suitable for foliage and landscapes generally. Another green is obtained with:

Sulphuric acid	6 cc. m.
Water	240 cc. m.

Should any perceivable sign of reticulation appear during the use of any of the alkaline solutions, it is advisable to remove them at once, to a weaker solution.

Blue.—For blue, extract of indigo will be found to answer best. Aniline is liable to fade.

There are numerous other dyes and toning solutions that might be employed in toning and intensifying carbon pictures, but the list given will answer the requirements of the most fastidious carbon printers.

LOCAL TONING.

Very agreeable color effects may be produced by toning the different parts of a picture or transparency with a brush. For instance, a landscape with green trees, rocky cliffs, and blue sky may easily be transformed into a colored picture by employment of the different toning agents given in this chapter.

The manner of proceeding, is to lay the picture down upon a level surface and, without previously moistening the film, apply the toning solutions with a suitable camel's hair brush. When enough has been absorbed by the film to give it the desired tone or color, remove the superfluous solution with a tuft of absorbent cotton or a piece of lint-less blotter.

The toning solution, applied in this manner, should contain a little starch, gum arabic or glycerine, to keep it from crawling or spreading too freely.

The amateur finds more pleasure in this kind of work than the professional; for the reason that it takes considerable time and lots of patience, to do it, and to do it right.

CHAPTER VI.

THE REPRODUCTION OF NEGATIVES FROM CARBON POSITIVES.

FOR THIS purpose, the carbon positive is greatly superior to all others, and if it were but for this purpose alone, it would amply repay every photographer for the trouble of acquainting himself with the working details of this valuable process. The exquisitely fine deposit of a carbon transparency faithfully renders the most delicate details and gradations of light and shade of the original negative.

This superior quality of the carbon positive makes it possible to reproduce enlarged negatives of quite extended dimensions, without showing the least particle of structure, or grain; and are equal, and very often superior, to the originals.

The negatives enlarged from carbon transparencies may be greatly improved, and the work on the enlarged negative reduced by skillful touches of brush and pencil, both on the original negative and the intervening positive.

The majority of printers, however, prefer to leave the original negative, and also, the positive, untouched, so as to get full detail into the enlarged negative, and in that way are enabled to produce a faultless likeness, and a picture that is equal, in every respect, to one made from an original negative.

The most approved method for producing enlarged negatives is to make a large positive, the exact size of the intended negative, by daylight in the copying camera, or by means of artificial light, with the enlarging lantern. Upon

this enlarged positive all the improvements possible may be made by carefully retouching it on both sides, and then making the large negative from it by contact, and again retouching the negative.

This method involves more labor and expense, but produces the most perfect results; in fact, there is very little or no difference between these and original negatives.

The negatives, unless it be for making solar enlargements, are made on any good brand of dry plates. The positives, only, are produced by the carbon process. These positives must be printed very deep, so that they appear greatly over-printed, and should always be printed upon transparency tissue, quite old, and dried against some rigid support, either glass or ferrotype plate. Otherwise the positive might not be perfectly sharp on account of the tissue not having a perfectly smooth surface, which would prevent it from coming in proper contact with the negative.

One of the oldest methods and one that can be especially recommended, is, to coat the required number of plates with a 1 per cent collodion, which when set, is rinsed with filtered water until the greasy lines disappear, and dried, or, left in the water until wanted; which might be several hours, without injury.

When the printed tissue, immersed in the cold water, flattens out, take one of the collodionized plates, rinse it quickly under the tap and slip it under the tissue. Then bring it in contact with the plate under water and place it on the squeegee board, where it is brought into intimate contact with the squeegee. It is then allowed to rest a half hour and developed.

Or, instead of collodionizing, the plates may be coated with a rubber substratum, which answers the purpose admir-

ably; the tissue adheres well to either surface and the intensifier or redeveloping agents do not stain it as they would the gelatine substratum.

Positives or negatives that may be printed from either side, are made in the following manner.

The perfectly clean plates are first waxed and then coated with a heavy leather collodion, or with the following.

Alcohol	4 ounces
Ether	4 ounces
Amyl acetate	8 ounces
Gun cotton	240 grains

Before coating, the waxed plates must be edged with rubber or chrome gelatine.

After coating these plates must then be allowed to dry, and are then again coated with a very thin substratum of chrome gelatine, and when dry are then ready for use.

Should the positive lack intensity or color, it may very easily be intensified by various methods of which the following is one of the best:

No. 1.	Permanganate of potash	1 dram
	Water	30 ounces
No. 2.	Water	30 ounces
	Glycerine	½ ounce
	Ammonia (liquid)	½ ounce

For use, mix equal parts of No. 1 and No 2. and immerse the film until the desired color or density has been obtained, which is sometimes very quickly done. The color produced by this method is an olive green, which is valuable in bestowing upon the negative or positive better printing qualities.

Instead of using another positive film, an ordinary dry plate of a slow variety may be employed.

Negatives of the same size as the positive are usually

JOSEPH NICÈPHORE NIÈPCE

made by contact. Reduced, or, enlarged negatives are made in the copying camera.

The best way to make a negative from a positive by contact, is to make it in the camera. Direct the lens towards a sheet of white paper or cardboard placed in a good, strong light, and then place the positive into the holder and a good brand of dry plate back of it; make the exposure and develop in the usual way.

CHAPTER VII.

CARBON ENLARGEMENTS—BY ARTIFICIAL LIGHT AND THE SOLAR CAMERA—THE NEGATIVE.

CARBON enlargements, by either artificial light or solar camera, require thin, delicate negatives full of detail and fine printing qualities.

For the production of negatives of this kind the carbon transparency serves as an almost perfect medium.

The special transparency tissue, when dried against a rigid support, will produce positives of a superior quality, such as could not easily be equaled by any other process.

When a satisfactory transparency has been obtained, repeat the operation with it, and the result will be a negative, which may be improved in various ways to obtain the best results.

The glass for this purpose, should be a thin, white crystal, as free from scratches and blemishes as possible, and should be coated with a substratum of rubber of collodion applied as given in the previous chapter.

The developing manipulations are precisely the same as for single transfer pictures.

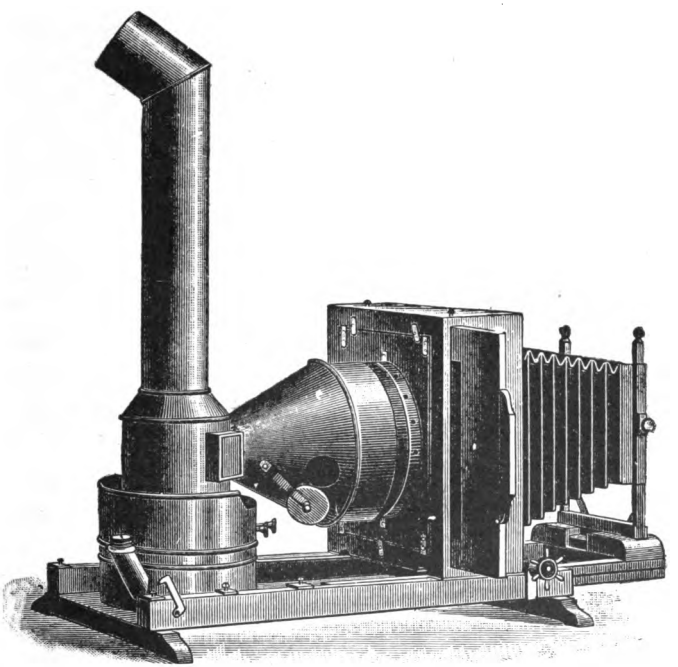
It is not strictly necessary, however, to make a carbon negative. The positive may be placed into a copying camera and a negative made upon any good brand of dry plate. Or, if familiar with the wet process, a collodion negative will answer the purpose almost better than any negative dry plate made. Thin negatives, such as are used for aristo paper, may be printed from as they are, if electric light is the

illuminant; and the work of making a duplicate negative may be dispensed with.

THE ENLARGING LANTERN.

Almost every photographer engaged in the business to any extent in these days of bromide enlargements, is familiar with, or possesses, an enlarging lantern of some kind.

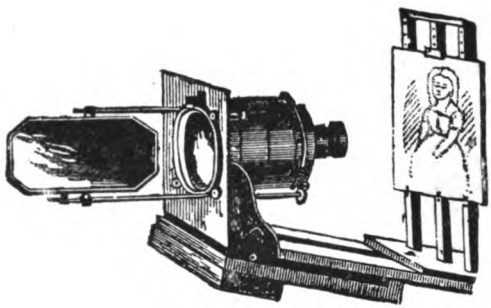
The condensing lenses should be at least eight or ten inches in diameter. With these, it is possible to get a strong and even illumination, and uniformly exposed pictures, clear to the edges of the negative.



ENLARGING LANTERN.

The best and most sensible, and the only way, to employ an enlarging lantern right, is to construct a permanent stand

for it, where it is handy and always ready whenever required for use. The value of such an arrangement cannot be over-estimated. Nearly every one dislikes the trouble of arranging shaky tables, boxes, etc., every time there is a print to make. A permanent arrangement will do away with this bother and makes the enlarging lantern more popular in the studio.



THE SOLAR CAMERA.

The solar reflector will be found the most convenient for this class of work. These instruments are too well known to need any further mention here. The work is the same as that with the enlarging lantern, with the exception of the exposure, which must be considerably shorter. The actinometer is placed within the circle of illumination where it does not interfere. The developing is done in precisely the same manner as previously given for ordinary carbon pictures.

The recent improvements in electric lamps greatly facilitates printing operations in the studio; so that the photographer who is equipped with one of the new photo-electric printing lamps is no more dependent on the suns rays; but can turn out a uniform lot of prints in any kind of weather, and do it promptly.

The carbon printer is further greatly benefited by this system: The printing may be done where the atmosphere is dry and temperature moderate and uniform; which keeps the tissue in fine working order and produces the very best results.

Another great benefit derived from the use of the electric light, are the splendid results obtained with the enlarging lantern. Beautiful enlargements, almost equal to pictures made from original negatives, and they are as readily and cheaply produced as solar prints.

The sensitive paper may be tacked up, and exposed in the same manner as bromide paper, with the exception that the actinometer must be placed in the circle of light, or a light print may be made on aristo paper and the exposure timed. The carbon tissue is then exposed for exactly the same length of time, and will be found approximately correct.

Probably the best and most expedient way of making carbon enlargements with the enlarging lantern is to polish a perfectly clean glass with waxing solution, after the manner of waxing a temporary support, for the double transfer process. Squeegee the sensitive tissue against the prepared surface of this glass, as it comes from the sensitizing bath. When dry, clean the glass well, and make the exposure through the glass. The experienced workman will readily see the advantage in this manner of working. The picture will be uniformly sharp all over, and the tissue being already in contact with the glass and may be developed immediately after exposure, if intended for double transfer; if for single transfer, it must be stripped from the glass, and transferred to whatever support it is desired, celluloid, paper, opal glass or porcelain. The sensitive tissue brought in contact with a clean glass is well protected from dust and foul gases, and therefore always produces nice, clean pictures.

CHAPTER VIII.

FAILURES, THEIR CAUSE AND REMEDY.

THE carbon process, like all other printing methods, requires a certain amount of practical experience to enable one to become a thoroughly capable and proficient carbon printer. Until this is the case, failures will occur, which, in a moderate degree, are valuable lessons for the beginner in carbon printing.

Were the process entirely devoid of difficulties and failures, it would find but little favor among skilled workmen. It is the perplexities, and the difficulty to master them, that lend a certain charm to the process.

The following are a number of failures that are apt to occur with beginners, but never trouble the expert:

1. *Failure.*—After sensitizing carbon tissue in the hot months of summer, the film softens and runs down in streaks.

Cause.—The temperature of the drying room was too high, the bichromate solution was too warm, or the gelatine was of a poor quality.

Remedy.—Cool the bath to 50° F. or lower, and if the tissue seems all right when taken from the bath, but starts to run down in streaks after it is hung up, it is plainly evident that the room is too warm. Lower the temperature and increase the draught. An electric exhaust fan is the proper caper, or lay the tissue flat until partly dry.

2. *Failure.*—The tissue cockles and cannot be brought in proper contact with the negative.

Cause.—The superfluous solution was not evenly removed from the back of the tissue. Sometimes drying the tissue too quickly and too long will have the same effect.

Remedy.—Remove the moisture from the back of the tissue as evenly as possible. Tissue in that condition must be allowed to absorb moisture enough to make it pliable; then, covering it with a clean piece of paper, roll it tightly around an inch (or larger) roller and let it remain for an hour. With the use of squeegee plates this never occurs.

3. *Failure.*—The tissue does not adhere to the transfer paper, celluolid, etc., and when attempting to remove the paper support from the film, it is done with difficulty and usually tears through on the darker parts of the print, which is pulled from the support. Or, after the paper has been removed, it is impossible to cause the gelatine to become soluble, and the picture remains buried in an insoluble mass of pigment.

Cause.—The insolubility of the tissue is either caused by a warm sensitizing bath; a poor quality of bichromate; drying too slowly, or it has in some way been exposed to white light, and continuous insolubilization; the tissue was over-exposed, or left too long before development; the tissue was too old.

Remedy.—Remedies for the above failures suggest themselves. Keep the tissue in total darkness until ready to use. After tissue has been excited for ten days in winter, insolubility may be expected. Four days in summer is about the limit unless a preservative such as accelorine is used. Develop as soon as possible after exposure.

4. *Failure.*—The edges of the film wash up during development, otherwise no difficulty occurs.

Cause.—The tissue was allowed to remain too long in the water before effecting the transfer, or the moisture on

the margin of the support was not blotted off after the transfer.

Remedy.—As soon as the tissue flattens out place it upon the support and apply the squeegee. Sometimes when the negative is masked on the film side the heavy shadows will wash up where they are cut off abruptly. Mask on the glass side. Dry the back of the tissue as well as margin of the support well after making the transfer.

5. *Failure.*—The picture appears dark and heavy and is difficult to develop.

Cause.—This is due either to over-exposure or the tissue had become partially insoluble. It was too old.

Remedy.—Shorter exposure or the addition of a little bicarbonate of soda, or common salt, will sometimes help a tardy development. In obstinate cases use carbon reducer. Should this fail, the tissue is insoluble, and it would be a waste of time to do anything further with it.

6. *Failure.*—The picture develops too readily; appears chalky and without half-tones; is too light.

Cause.—A weak sensitizing bath, or the tissue being too new will cause this trouble, but usually it is caused by insufficient exposure to light, or water too hot at the beginning of development.

Remedy.—A sensitizing bath of the proper strength. The tissue should be at least a day old in summer and three days in winter to give good results. Development must be started at a lower temperature. If the tissue is too fresh, expose it to diffused light a few moments or flow it with a 1 per cent collodion before putting it onto the negative and it will then probably work all right.

7. *Failure.*—The picture appears veiled with a fine, black network, reticulation, or it is granular.

Causes.—This trouble appears mostly during hot weather

or is caused by immersing the tissue in water of too high a temperature when effecting the first transfer. Too much alkali and sudden changes in temperature cause coarseness and granularity.

Remedy.—Immerse the tissue in water at about 50° F. The addition of a little salicylic acid, or a few drops of a ten per cent solution of a bichloride of mercury to the sensitizing bath in summer, will cure this evil. Slow drying of the tissue, enough to cause a slight insolubility all over the surface, a weaker sensitizing bath, or a thin coat of collodion, are all effective remedies for this trouble.

8. *Failure.*—Tiny air bells that cause little shiny specks.

Cause.—This trouble arises from air being imprisoned between the tissue and support; the generating of carbonic acid gas between the film and support; the development was commenced with water at too high a temperature; the water used to eliminate the alum was too cold. Use water at 65° or 70° F.

Remedy.—Before placing the tissue upon the support remove all the air bells and froth adhering to the surface with a soft camels-hair brush, then take it by the corners diagonally opposite and place the diagonal line upon the support first, and then carefully let down the corners, apply the squeegee from center to side, and the trouble cannot be blamed to the transfer manipulations. Very often, and especially with pictures on celluloid this trouble occurs between the film and support, especially when very hot water has been used for development and the print was immersed in cold, hard water afterwards. Let the print soak in cold water for half hour before development and then raise the temperature gradually. Tap water coming from the hydrant under high pressure always contains a great deal of air, and

is almost unfit for developing carbon pictures. Soft water throughout the development always gives the best results.

9. *Failure.*—The tissue refuses to adhere to the support. The film rises when warm water is applied.

Cause.—The tissue had remained in the cold water too long before it was transferred to the support; or it had been exposed to foul air or gases, etc. On celluloid, the substratum was too soft.

Remedy.—Put the tissue under pressure for an hour, then start the development in water at a medium temperature, and gradually increase it until the pigment begins to ooze out around the edge, then strip the paper from the back, lower the temperature and proceed carefully until the desired effect has been obtained. Use a good, hard gelatine for a substratum on celluloid.

10. *Failure.*—The tissue does not adhere to the collodion plate (double transfer.)

Cause.—The tissue was too old or had become partly insoluble.

Remedy.—When the tissue is not fresh, or in warm weather, flow the collodionized plate with albumen, or a two per cent solution of hard gelatine containing a little chrome alum will answer.

11. *Failure.*—The picture appears to be full of little black specks.

Cause.—Particles of dirt or tissue imprisoned between the film and support, sometimes adhering to the surface. Often, when water has been used for several prints it becomes full of little black particles that have become detached from the borders of the tissue. These adhering to the surface become imprisoned between the film and support and give rise to black specks.

Remedy.—Use fresh water.

12. *Failure.*—The picture appears granular.

Cause.—The paper was dried at a very high temperature, or had been exposed to bad air, or gases. The use of too much alkali; or the tissue was not in contact with the support long enough before it was developed.

13. *Failure.*—Pictures developed upon glass plate become reticulated.

Cause.—The exposed tissue was immersed in warm, instead of cold water, when the first transfer was made.

Remedy.—Make the first transfer in cold water. When developing, soak in cold water first, and then gradually raise the temperature to a point that will cause the solubility of the gelatine, then remove the paper and proceed with the development at a lower temperature.

Use soft water at a medium temperature. Keep the print under water after the original paper support has been removed, until the bichromate is well washed out.

14. *Failure.*—The picture appears cloudy, especially in the lighter parts. Looks patchy.

Cause.—Pressure of the fingers on the back of the tissue; pouring hot water on the back of the tissue or the use of old blotters that are full of gelatine; the celluloid was not clean; too heavy pressure on the squeegee.

Remedy.—Avoid getting the fingers in contact with the face of the tissue, and the pressure of the hands against the moist paper on the back when effecting the first transfer. Use only clean blotters and see that the celluloid is perfectly clean. Do not use quite as much pressure on the squeegee, and do not strike the tissue with much force when placing the squeegee upon it during transfer.

15. *Failure.*—The pictures refuse to leave the temporary support when making the final transfer.

Cause.—This trouble is caused entirely by the faulty waxing of the temporary support.

Remedy.—Use none but pure wax, and immerse the plates in a 5 per cent chrome alum solution and rinse well before using. The addition of a little resin will help overcome the difficulty. New plates should be polished but very little, or not at all. After the plates have been re-waxed several times this trouble never occurs.

16. *Failure.*—It sometimes happens that the picture will not adhere to the final support.

Cause.—This will happen when the gelatine is dissolved away from the surface of the support—the temperature of the water in which it was immersed to soften the gelatine, was too high. Or, if the print had been left too long in the alum, it will have the same effect.

Remedy.—The remedies to overcome these difficulties suggest themselves.

17. *Failure.*—Pictures developed in the vertical tank are covered with froth causing tiny little white specks.

Cause.—Sometimes water passing through certain kinds of heaters by direct pressure, is filled with air; this gathers in minute little air-bells upon the face of the film and gives rise to this trouble.

Remedy.—Pass the water through some kind of a filter —chamois or fine muslin will do. Or see that it contains no air.

POOR, WEAK, SUNKEN-IN, FLAT OR GREY PRINTS.

Most usually result from negatives poor in quality.

Like in the silver process, a good negative with lots of snap will produce a vigorous, fine-colored print, and a weak lifeless negative will make a poor grey print.

The latter only occurs with the student or beginner; of

course, the expert can tell at a glance when he sees a negative, what to do, to get the best possible results. For weak, flat negatives in proper hands, can be made to yield good prints.

CONDITIONS OF PERMANENCY.

Fading and deterioration is as likely to occur with pigment pictures as with any other make. As a rule, they are considered permanent, which they certainly are if the pigments employed are not of a perishable nature.

Gelatine, which is very extensively employed, in the process, is a durable substance, especially when endurated or hardened with alum.

The coloring matter that enters into the make-up of carbon tissue is chiefly composed of pure carbon or lamp black, and is probably the most imperishable substance employed as a coloring matter, in photography. Most of the pigments used as coloring matter, are just as permanent, and for this reason, carbon pictures may be regarded as absolutely permanent as far as the coloring matter is concerned, unless some of the other constituents of the tissue are of poor and unstable quality. In the majority of cases, fading and deterioration is plainly traceable to carelessness or lack of understanding on the part of the operator. If he neglects to thoroughly eliminate all traces of bichromate from the film or support, fading is sure to follow.

A very strong solution of alum, will materially affect the print, and if not thoroughly eliminated from the support, will ultimately bring ruin to the picture.

Some pigments are effected by acids, and others by alkalies; therefore all the conditions pertaining to permanency must be studied and applied to good advantage to obtain the best results.

Part V.

THE APPENDIX

CHAPTER I.

CARBON TISSUE.—HOW MADE, AND THE MATERIALS REQUIRED IN ITS MANUFACTURE.—THE MANUFACTURE OF CARBON TISSUE IN THE STUDIO.

Of the vast amount of carbon tissue annually consumed in this country, 75 per cent is of foreign manufacture.

Some years ago a firm in Boston ventured into the manufacture of carbon tissue in this country, but for lack of encouragement, and the incongruities of the carbon process, at that time, it was again abandoned.

Notwithstanding, that there is now a plentiful supply of excellent carbon tissue on the market, it will nevertheless stand the wide-awake and up-to-date carbon printer in hand to be perfectly familiar with, and fully understand its manufacture, as well as its use.

For that reason, and for the sake of completeness, I will give a full and lucid description of the entire process of manufacturing all kinds of pigment or carbon tissue in the studio.

Before proceeding to describe the actual manufacture of the tissue, however, a little preliminary explanation regarding the different constituents that enter into its make-up, will here not be out of place.

In the first place, the paper used for this purpose should be rather tough, with an even smooth surface texture, and contain very little size, to be easily permiable by water.

The gelatine is probably the most important factor in the manufacture of a good carbon tissue. There are several varieties of hard and soft gelatine especially suited for this purpose, on the market; of these, Nelson, No. 1, is probably the best; it is, however, too readily soluble and for that reason must be mixed with a hard gelatine, such as Coignets or Winterthur. If a tough film is desired, an addition of 10 to 20 per cent of a good isinglass (Astrakhan Leaf), must be added. Some of the soft gelatines, and especially the American makes, are too freely soluble in warm water, and if employed in the manufacture of tissue, the resulting pictures will be weak and faded in appearance; and especially in the hot days of summer, such tissue will yield very inferior results.

On the other hand, if the gelatine is too hard and probably contains considerable alum, the tissue will be sparingly soluble and it will consequently be impossible to obtain satisfactory results. The pictures will be heavy and veiled—and very flat.

A gelatine suitable for carbon tissues should absorb from 12 to 18 times its weight of cold water in 24 hours; if it absorbs less, it is not so well suited for the purpose.

There are some makes of gelatine that contain fatty substance, which, if used for carbon tissue, will be very injurious to the film, causing irregular light spots upon the pictures.

Gelatine and pigment alone, would make a hard and very brittle tissue; therefore, to make it more pliable, we must add sugar, soap and glycerine, to the compound, which im-

parts to it the different qualities necessary to make a good tissue. An addition of sugar is recommended by most manufacturers, but it must be used with judgment; an excess will make the tissue too freely soluble and very brittle in dry, hot weather.

From ten to twenty per cent in weight, of the dry gelatine, will be the proportion to use, greatly depending upon the purpose for which it is intended.

Glycerine makes the tissue very pliable and if used in excess, will show it considerably and also make it too freely soluble, causing great contrast, and loss of half tones.

A moderate use of glycerine makes brilliant prints, with beautiful whites, and may be used to good advantage on weak, flat negatives.

An addition of soap to a pigment compound causes a better distribution of the coloring matter, and causes the gelatine to flow more evenly. It also make sthe tissue pliable, and greatly adds to its solubility. Ten per cent in weight of the gelatine, is about the right proportion to use. Isinglass is often used instead of soap; besides making the tissue more soluble, it makes a stronger, tougher film.

CHAPTER II.

THE CHOICE OF PIGMENTS OR COLORING MATTER.

THE choice of pigments, or coloring matter, in the manufacture of carbon tissue, is of the utmost importance; for the reason that richness and brilliancy of tone depend nearly altogether upon the brilliancy and colorific power, as well as stability of the pigments or coloring matter used.

Unfortunately, the most beautiful and brilliant colors of the painter's palette, are the most fugitive, and the ones that should be the most carefully avoided in pigment printing, if absolutely permanent pictures are desired.

There are, however, a great variety of other pigments available, aside from the unstable ones; that may be safely employed in the manufacture of carbon tissue.

With these and their combinations, the skillful operator is enabled to produce the most charming pictures, in a great variety of tones, that, for richness and beautiful color effects, surpass anything that has even been attempted by any other process.

Cold, or dull and heavy pigments, should, if possible be avoided; they make dull, lifeless pictures; with a little warmth, the results will always be more pleasing.

Often flatness and loss of vigor, is due to soluble coloring matter, or the pigments are affected by the action of some of the chemicals used in the process.

We will take for example, ultramarine, which under ordinary conditions is said to be perfectly permanent, and is often referred to as the most staple of all the blues.

In the carbon process it is affected by a strong alum solution and in the presence of nitric acid, it loses its beautiful blue color, leaving an earthy, yellowish-grey deposit.

The true color or tone of a pigment picture, can only be seen in the half tones or middle tints, and cannot be judged from the color of the tissue as it appears before development.

The commercial carbon tissue now obtainable, embraces at least twenty-five different colors; of which warm black, engraving black, standard brown, sepia, lambert-type purple, sea green and red chalk, are the most used.

For the benefit of those who are not familiar with the nature and properties of the various pigments, I will now give a short description of such colors, that may be safely employed in the manufacture of carbon tissue.

DESCRIPTION OF PIGMENTS.

Lampblack.—This is mostly a pure vegetable carbon of fine texture, obtained by burning resin or pine pitch, turpentine and camphor. Also from the imperfect combustion of bone oil or coal tar. It is not so intense or transparent as ivory black and much less brown in tone. It makes a splendid engraving black or transparency tissue.

If a cold tone is desired, add indigo or cobalt blue. If warmth is wanted, add alizarin or venetian red.

It is a dense solid color and should be used sparingly. It is the most permanent black known, and is used extensively in the manufacture of india ink and printer's ink.

Ivory Black.—This is a rich, velvety black, of a brownish tone. It is obtained by calcining ivory in a closed crucible. With the addition of a litle blue and red it makes a splendid warm black; is as permanent as lampblack, but is considerably more expensive.

Drop Black.—Is a good black; a little colder in tone than ivory black; is much cheaper, and is perfectly permanent.

Frankfurt Black.—(Blue Black.) This is made of charcoal and calcined prussian blue; also burnt vine-twigs and cocoanut shells. Is permanent.

Venetian Red, or Scarlet Ochre.—This is an oxide of iron, prepared by calcining sulphate of iron with the addition of a little nitric acid. The result is, a peroxide of iron. It is considerably stronger, and has much more of a scarlet hue than light red, is considered perfectly permanent, and is a very useful color in preparing the different shades of pigment tissue.

Madder Lake.—These colors are extracted from the roots of the Rubia Tinctorum, and are the most permanent of the lakes. They are used in the carbon process chiefly, to enrich and liven up other pigments.

Cobalt Blue.—A silicate of cobalt and potassium, or a compound of cobalt and alumina. This is a brilliant blue, and probably the most permanent of all the blues.

Ultramarine.—This beautiful color is made of silica alumina, soda and sulphur. It mingles well with all the other pigments and is thoroughly permanent, providing it does not come in contact with an acid, or is mingled with acid pigments. Acid solutions of every kind should be carefully avoided to insure pemanency. A strong alum solution affects the color of artificial ultramarine.

India Ink.—This is a fine opaque black body prepared of shellac, 20 parts, borax 40 parts, refined lampblack in water, 80 parts.

That of Chinese manufacture is refined lampblack mixed with oil of sesamum (tilseed) and a little camphor.

In the carbon process it is chiefly employed in the manu-

facture of transparency tissue, for which purpose it has no equal. It is absolutely permanent.

Van Dyke Brown.—This is a deep semi-transparent pigment. With the addition of a little alizarin and india ink, it makes a fine brown tissue. Is permanent.

Burnt Umber.—Is an agreeable olive-brown color, and is perfectly permanent.

Sepia.—Sepia is the ink of the cuttle fish, consisting of carbonaceous particles, and animal gelatine. It has a transparent, dusky brown color. The addition of a little burnt sienna will give it more life. It is a permanent and easy working color.

Bistre.—This is made of the finer parts of beechwood root, and is extracted by a watery solution. It has an intense citrine-brown color and is employed for sepia tones. It is perfectly permanent.

Burnt Sienna.—A reddish-brown pigment sometimes employed in the manufacture of sepia tissue. Is considered permanent.

Prussian Blue.—A good, powerful and yet transparent pigment; consisting of carbon, nitrogen and iron; it is fairly permanent, but not as much so as cobalt or ultramarine. Mixed with gamboge, it makes a permanent, bright green color.

The action of a strong alkali decomposes it; but the employment of hydrochloric acid will again restore its former color.

Strong light will weaken its color, but when placed in darkness its former brilliancy returns.

Cobalt Green.—This color is a compound of zinc and oxide of cobalt, and is considered perfectly permanent.

Terre Verte.—Is a perfectly permanent color if not allowed to come in contact with acids.

The preceding list of pigments are the most desirable as well as the most permanent colors of the painter's palette, and may safely be employed in the manufacture of pigment tissue.

Any of the above colors can be bought finely ground and in a moist state, contained in tubes or bottles of various sizes.

CHAPTER III.

THE MANUFACTURE OF CARBON TISSUE IN THE STUDIO.

THE manufacture of carbon tissue has assumed quite extended proportions and it is now furnished by the makers in a uniform and most excellent quality.

Some of these tissues possess a very high degree of excellence, which for rich and beautiful coloring, uniformity, and fine printing qualities, cannot be surpassed.

While the manufacture of carbon tissue in the studio is not at all difficult, it must, of course, not be expected that an amateur or professional who undertakes to make a small batch of tissue, could equal in uniformity and quality of fineness, the products of the manufacturer who has all available resources at his command, and probably possesses the most perfect machinery and apparatus, that modern skill and ingenuity can produce.

It is nevertheless true, however, that some very excellent tissue can easily and profitably be made in the studio, if the instructions given in this treatise are strictly adhered to. Furthermore, to be successful, every expert carbon printer ought to understand perfectly, and should be thoroughly conversant with all the mechanical details as well as chemical manipulations involved in the process and manufacture of carbon tissue.

It will prove an advantage, not only in familiarizing him with the tissue in all the after manipulations, but it will enable him, to at once locate and overcome any difficulty that might arise at any stage of the process.

Where carbon printing is carried on extensively, odd shades are often in demand; not being obtainable commercially, it is certainly a great advantage if the operator can produce the desired article in the studio. Another great advantage found in the manufacture of pigment tissue in our own laboratories, is that it can be made to suit any class of negatives we may desire to print from.

For instance, if we wish to make a tissue that will yield a strong brilliant picture, from a thin flat negative, it is only necessary to increase the quantity of coloring matter, or reduce the thickness of the translucent film composing the tissue, to obtain the desired effect.

By this it will readily be seen, that by making a print upon a paper having a thin film of gelatine, containing an abundance of coloring matter, the resulting picture will be strong and brilliant, with vigorous contrasts and perfect gradations, impossible to obtain with tissue not suited for that class of negatives. And again on the other hand, by preparing a tissue with a thicker or more translucent film of gelatine, containing less coloring matter, hard negatives with excessive contrasts, may be made to yield soft and harmonious prints.

Thus it is possible by judiciously preparing the pigment compound, to produce a tissue having the printing qualities so regulated as to greatly ameliorate the faults and imperfections of weak, flat negatives and those that possess too much contrast, and are too harsh for ordinary printing methods.

But of course, in view of all these possibilities, it should not be understood or expected, that the results obtained by these methods would be equal to the pictures produced from negatives possessing fine gradations or first class printing qualities.

The commercial tissue now procurable, is manufactured in a sensitive and insensitive state. Tissue in an insensitive state will keep indefinitely if stored away in a dry, cool place, and may be excited or made sensitive to light whenever desired for use.

Sensitive carbon tissue has the exciting agent incorporated in the pigment film with which it is coated, and is only obtainable in the immediate vicinity of the factory, on account of its rapid deterioration, especially in hot weather. Its keeping qualities are limited to 3 or 4 days in summer and about two weeks in winter.

This tissue will yield finer results, and is manipulated with less difficulty than that which is made sensitive as required.

It is therefore advisable to purchase tissue whenever it can be obtained, in a fresh and workable state.

CHAPTER IV.

THE GELATINE COMPOUND.

The first step in the manufacture of carbon tissue, is to prepare the preliminary jelly, as it is called.

The following are a few of the best formulas known, and are highly recommended by all who have tried them.

Gelatine (medium)	100 to 130 oz.
Sugar	20 oz.
Soap	5 oz.
Coloring matter	3 to 6 oz.
Water	400 c. c. m.

The proper way to prepare the above emulsion is to put the gelatine, sugar and soap into the cold water and let it soak for about an hour.

During this time the gelatine will have absorbed enough water to soften it, and it will dissolve very readily.

Place the vessel in a water-bath and gradually raise the temperature to 100° F. When it has all dissolved, stir well to mix the soap and sugar with the gelatine, and pour the solution into a vessel tapering towards the bottom. Let cool gradually, to allow all the impurities to settle to the bottom. When cold, drop the whole mass into a clean flat dish and remove the sediment that gathered at the bottom, by cutting it away with a knife.

The gelatine is then ready to be incorporated with the pigment or coloring matter.

When mixing up the pigment compound, weigh out the coloring matter, and in a good size morter, grind it well together with a little warm gelatine.

Then melt the remaining gelatine and gradually pour it into the pigment mass, in the morter, and thoroughly mix; then filter through fine muslin and the compound is ready for use.

The following is also a very fine formula for preparing pigmented gelatine:

Water (distilled)	25 ounces
Gelatine (Nelson's No. 1)	400 grains
Gelatine (Nelson's amber)	3000 grains
Soap (pure white)	200 grains
Sugar	1 to 2 ounces

Soak the gelatine for an hour, and add the soap and sugar, and, placing the mass in a water bath, dissolve by gentle heat.

Mix the coloring matter with a little gelatine to the consistency of a thin syrup and then add the whole to the gelatine and stir well; when thoroughly mixed, filter through fine muslin and the compound is ready for use.

If the pigment tissue is intended for immediate use it is best to add the sensitizing agent to the compound. To the above quantity of emulsion add 300 gr. bichromate of potash and from 50 to 150 grains of crystallized carbonate of soda.

C. P. This will coat a roll of paper 30 in. by 12 ft. long.

MIXING THE PIGMENTS OR COLORING MATTER.

Any tone or color may be given to the tissue, and the quantity of coloring matter regulated to suit the density of the negatives to be printed from. Warm black, sepia, purple, standard brown, sea green and red chalk, are colors that are mostly used for the ordinary run of studio work; all other shades are intended for special purposes, and are only in demand at times.

The pigments or coloring matter usually employed, are

finely ground water colors, put up in tubes, bottles or jars, in a moist state.

These pigments when fresh, contain about one-half their weight in water, for which an allowance must be made when used for coloring carbon tissue.

WARM BLACK.

Lampblack or India ink	100 grains
Burnt umber	60 grains
Carmine lake	94 grains
Indigo	32 grains

ENGRAVING BLACK.

Chinese ink or lampblack	60 grains
Indigo	30 grains
Carmine lake	64 grains

SEPIA.

Sepia of cologne	550 grains
Lampblack	68 grains

DARK BROWN.

Lampblack	464 grains
Indian red	94 grains
Carmine lake	24 grains
Vandyke brown	64 grains
Indigo	38 grains

RED BROWN.

Vandyke brown	125 grains
Carmine lake	156 grains
India ink	94 grains

PHOTOGRAPHIC BROWN.

Chinese ink	125 grains
Indian red	156 grains
Carmine lake	94 grains

CHOCOLATE BROWN.

Lampblack	48 grains
Alizarin (dissolved in soda)	8 grains
Peroxide of iron (dry hydrated)	32 grains
Purpurine	8 grains

BLACK TRANSPARENCY TISSUE.

Finest liquid India ink	180 grains
Jelly	2 lbs.

To obtain the very best results, dissolve one bottle of India ink in a quart of water and filter. Then evaporate the water and mix the color with the gelatine as previously directed.

The tissue thus obtained will yield the most perfect result, when employed for magic lantern slides or transparencies for carbon enlargements.

The exquisitely fine deposit of color in these positives will admit of enlargements being made, of quite extended dimensions, without showing the least particle of structure or grain.

RED TRANSPARENCY TISSUE.

India ink	64 grains
Indian red	90 grains
Carmine lake	156 grains

GRAPHITE TISSUE.

Pictures printed in graphite resemble pencil drawings, and present rather a unique appearance. For some purposes they give very pretty and artistic effects.

Grind the graphite well in a little glycerine before mixing with the jelly compound.

RED CHALK.

India red	156 grains
Carmine lake	90 grains
Lampblack	50 grains

WARM SEPIA.

Sepia of cologne	300 grains
Burnt sienna	100 grains
Indian red	50 grains
Lampblack	50 grains

SEA GREEN.

Chrome green	200 grains
Cobalt blue	10 grains
India ink	50 grains

MARINE BLUE.

Frankfurt blue	100 grains
Alizarin	15 grains
India ink	50 grains

TISSUE FOR TRANSPARENCIES AND LANTERN SLIDES.

Gelatine (Nelson's No. 1)	5 oz.
Winterthur gelatine	15 oz.
Rock candy	3 oz.
White castile soap	2 oz.
Distilled water	100 oz.

Allow the gelatine to stand in the cold water for about an hour, then add the soap and candy and dissolve in a water bath, by gentle heat. When dissolved add the coloring matter in the usual way; mix and filter through muslin.

To the above gelatine add the following proportions of coloring matter:

Black.—Chinese ink	16	parts
Vandyke brown	2	parts
Venetian red	2	parts
Violet Black.—India ink	20	parts
Indigo	2	parts
Carmine lake	1	part
Purple.—Chinese ink	5	parts
India red	5	parts
Burnt umber	5	parts
Indigo	1	part

To prepare the pigment compound, take of the above gelatine 30 parts, coloring matter 1 part. Coat at about 95° F.

The following formula is used by one of the most prominent carbon printing establishments in Germany:

Gelatine (Nelson's No. 1)	75 parts
Gelatine (hard)	25 parts
Pure white soap	5 parts
Rock candy	25 parts
Water (distilled)	300 parts
Coloring matter	3 to 5 parts

In a very dry atmosphere add 5 parts of glycerine instead of the soap.

As a coloring matter add any of the compounds given in the foregoing chapter. The proportions depend somewhat upon the density of the negatives to be printed from; if thin and delicate, add the full 5 parts; and if dense and contrasty add less.

There must be enough pigment, however, to make the film look quite opaque when coated on white paper.

If the above tissue is intended to be used up in from three to six days in summer, and from six to ten days in winter, it is advisable to add the sensitizing agent to the pigment compound, and thus save the extra trouble of sensitizing and again drying the tissue.

For the above amount of gelatine, dissolve 5 parts of bichromate of potash in 50 parts of water to which add about 70 grains of carbonate of soda, and filter. The tissue prepared in this manner, makes stronger and more brilliant prints than when coated in an insensitive state, and afterwards immersed in a bichromate solution.

WHITE TISSUE.

A white tissue may be prepared by mixing zinc white, flake white or Chinese white with the gelatine in place of coloring matter.

This tissue may be used for various purposes. The best results are obtained on dark red, purple or black supports, and printed from a positive instead of a negative.

Gelatine (medium) .....20 oz.
Sugar ....10 oz.
Glycerine ....1 c. c. m.
Sulphate of barium (neutral) .....
Water ....200 c. c. m.

The sulphate of barium must be in a neutral state and enough added to make quite a heavy deposit. When ready to coat, add 20 c. c. m. of a 10 per cent solution of bichromate of potash.

For soft delicate details, coat at a low temperature and cause the gelatine to set as quickly as possible and for strong contrasts, coat the paper while the gelatine is warm, and let set slowly.

This tissue is especially adapted for pictures of statuary —printed from positives. Printing this tissue an actinometer is superfluous, the print is visible in a brown tone on a yellow ground. Development takes place in the usual way.

POLYCHROME TISSUE.

A pigment tissue that produces rather striking effects, is composed of one or more layers of pigmented gelatine, each layer being of a different tone or color. Quite a variety of combinations may be made, but for general effects black and sepia, or black sepia and red, are good combinations.

For landscapes or views, sepia, green and blue, give very artistic and beautiful effects. The blue being the top layer, covers the lights, the green, the middle distance and lighter parts in the foreground and the sepia the darker parts such as the trunks of trees, rocks, and deep shadows, etc.

A careful printer can produce some very beautiful effects, and if skilled with brush and color can produce pictures that are truly beautiful. A similar process was patented by Baumgartner in 1882 and by Corwin Gitchell of San Fran-

cisco in 1896. These tissues are not obtainable commercially, but may be made in the studio to suit any purpose.

The process of Corwin Gitchell probably produces the most novel effects. Being a modification of the carbon or pigment process, it consists in the use of a multiple colored pigment tissue, having the pigments or coloring matter stratified or arranged in three distinct layers or strata, according to the effect desired to produce. The printing, transfer and development of this style of tissue is done in exactly the same manner as the ordinary carbon tissue. In the resulting print, those portions which correspond to the very dense part of the negative will appear in the color of the upper stratum, while those that rank next in density, will assume the color of the next stratum of pigment below, etc. For an illustration, we will take for instance, a landscape tissue, which is composed of three stratified layers of pigment, blue, green and brown.

The sky, being the denser part of the negative, will only allow the light to penetrate to the upper strata, which is blue; the foliage which is next in density will be penetrated to the second strata which is green; and the trunks of trees, rocks and all deep shadows will be penetrated to the third or brown strata. The half-tones of the upper strata will be blue-green, and in the lower stratas an olive gray; which produces a pleasant harmony of effects.

A tissue suitable for sunset or moonlight effects, is composed of two layers of pigments, a purple or indigo with a dark brown below.

The support or transfer paper used for this style of tissue may be tinted according to the effect desired to produce, thus. for a sunset or sunrise, it may be a pink or an orange, which gives beautiful mellow effects in the bright lights, and a variety of grays in the half-tones and darker shades. Thus a

great variety of effects can be produced with the use of these tinted grounds.

A variety of tissue, suitable for portraiture may be produced according to the color effects, desired.

One style of tissue produces a light brown or pink in the high-lights; which passes through several shades of brown and finally into a deep velvety black, in the shadows. This style of tissue gives a peculiar depth to the shadows impossible to produce by any other method.

The effects obtained are of the highest artistic value and are entirely different from anything ever produced by photographic methods.

The character of the results, of course, depends greatly upon the proper selection of the pigments, and the ground upon which the picture is transferred, to produce certain effects.

CHAPTER VI.

PREPARING THE PIGMENT COMPOUNDS.

THE best and most expedient way to mix pigment compounds, is to grind the coloring matter in about three ounces of warm jelly and when well mixed, melt the remaining jelly and stir it into the three ounces containing the pigments; now thoroughly mix and filter through muslin, and the compound is ready for use.

For mixing pigment compounds in large quantities, a suitable paint mill or mixer should be employed.

PROPORTIONS OF COLORING MATTER.

The exact proportions of coloring matter to use, depends considerably on the opacity and colorific power of the pigments employed, as well as the intensity of color sought for.

For tissue to use upon ordinary negatives and for no special purpose, a drop of pigmented gelatine upon a white piece of paper should appear quite opaque; if not, add more color. Most carbon printers prefer to use pigments that are inert or perfectly insoluble.

When a soluble coloring matter is employed, the prints should not be treated to a prolonged washing or soaking; or there will be a loss of brilliancy, and the prints will look flat and faded. For negatives of good printing qualities, about two per cent of carbon will be a good reliable proportion to use. It will be well to here again mention the fact that the real or actual color of a tissue is chiefly seen in the half-tones and lighter parts of the picture; and that it is quite difficult to distinguish the tone or color in the darker shades, especially in the blacks.

Also, that an increase of color, will add vigor and contrast to pictures printed from weak negatives; and a decrease of color, gives softness, where harsh contrasty negatives are employed.

COMPOUND FOR SENSITIVE TISSUE.

In preparing a sensitive pigment compound the sensitizing agent must be incorporated into the pigmented gelatine just before coating the paper.

For tissue to be used on ordinary negatives, about one part of a saturated solution of bichromate of potash to ten parts of the gelatine compound will be found a good, reliable proportion.

A compound having a large proportion of sensitizer is proportionately more rapid and is better suited for hard, contrasty negatives; but is considerably more difficult to manage. Tissue of that order works best when about two days old.

A compound with a small amount of sensitizer will make a slow tissue, which is easily handled and is best suited for weak negative. Works best when fresh.

CHAPTER VII.

COATING THE PAPER WITH PIGMENTED JELLY.

TO APPLY a uniform coating of pigmented gelatine of a given thickness over a sheet of paper, is usually regarded as a somewhat difficult operation which it certainly is, if a clumsy or improper mode of working is adopted. But, if the proper methods are employed, it will be found surprisingly simple and easy; and one fair trial will serve to overcome all hesitation and backwardness, usually found among the uninitiated, and will convince the most skeptical that a batch of splendid tissue, may be coated in less time than it takes to explain the process.

The success of the coating operations depends greatly upon the consistency of the gelatine compound.

If the temperature is too high, a thin and insufficient coating will be the result; in which case it must be repeated when the previous coating is dry, or the tissue would be useless.

If the temperature is too low, it will be hard to obtain an even coating, and the compound will be otherwise difficult to manage.

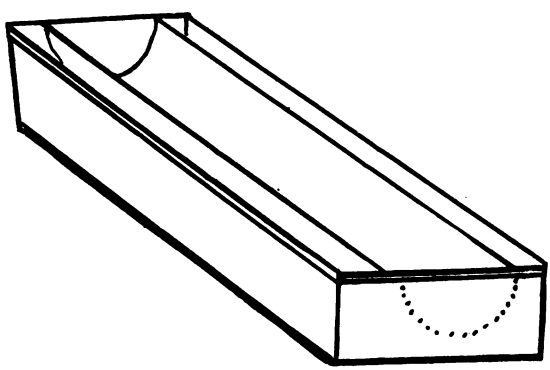
If the temperature is maintained at about 90° Fahrenheit, and the room properly warm, the coating will be done without the least difficulty. In order to make the film set quickly it must be put in a cool room immediately after coating.

Probably the most simple method of coating paper with a pigmented jelly is the following: Immerse a clean, flat sheet of glass into a tray of warm water; then immerse a

sheet of paper just a little smaller than the glass into the same tray. When the paper has expanded bring it in contact with the hollow side of the glass and place it upon a perfectly level surface; then immediately cover it with a lintless blotter and bring the paper into perfect contact with the glass, and while the paper and glass is still warm, carefully pour on a pool of the pigment compound and immediately spread it over the entire surface as evenly as possible with a strip of glass. If any air-bells appear quickly draw them to the side while the jelly is in a fluid state, but never attempt it after it has set.

Place the plate and pigment paper on a cool, level surface until the gelatine has set; when the paper may be hung up to dry. This is done by attaching thin slats of wood at top and bottom with photo-clips and hanging it on a tightly-drawn line or wire until dry.

Another method of coating pigment paper, which is probably a little more expedient than the former, is as follows: First sponge the paper with clean, cold water, and place one sheet over the other; then with the roller squeegee and a heavy blotter remove all superfluous moisture, cover with a clean sheet of glass and let rest for about an hour.



COATING TRAY.

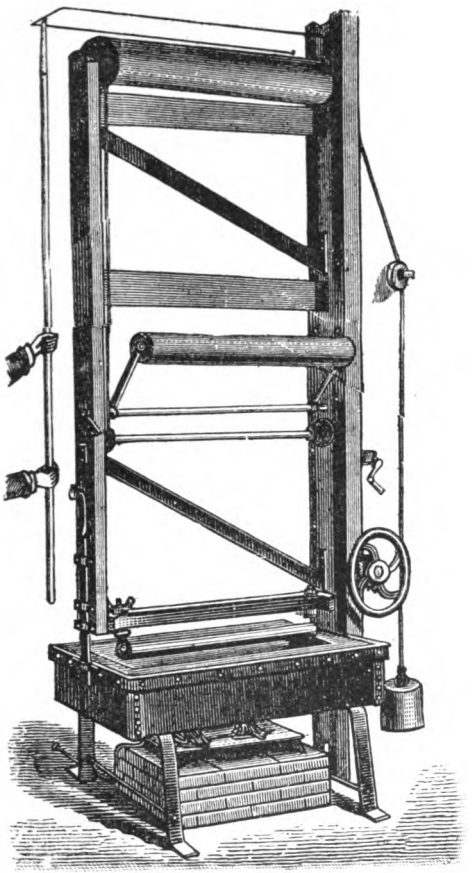
A double coating tray made of tin and constructed like the accompanying illustration will be found a very handy arrangement for the purpose.

Pour the gelatine mixture into the small tray, and fill the lower one with warm water, and place a small gas stove underneath to keep up a uniform temperature.

To coat, roll up the paper the narrow way, and carefully placing it upon the solution, take a hold of the corners opposite and immediately begin to pull it with an even upward motion, without stopping until the whole sheet unrolls itself and is pulled from the solution. If the temperature of the pigmented jelly was right to give it the proper consistency to hold the paper in proper contact, it will be pulled from the solution with a smooth, even coating, and the film will be sufficiently heavy; should it not be heavy enough, however, repeat the operation when the first film is dry.

Place the coated paper upon a clean, level surface, in a cool room until set; then place in a moderate temperature where it is dry and the air stirring, to cause a more rapid evaporation. Under favorable conditions, the paper will dry out in from 4 to 6 hours.

For the manufacture of carbon tissue on a more extended scale, a machine for coating bands or endless rolls of 12 or 15 feet in length, may be constructed, as shown in the illustration.



COATING MACHINE.

The upper roller ought to be about 3½ inches in diameter; the lower one about 1½ or 2 inches. The roller in the center of the frame, held by brackets should be about 2½ inches in diameter. The middle roller and the small one that carries the paper into the emulsion, must be just a little shorter than the width of the paper, for the reason that it must not be allowed to touch the solution, and the back of the paper is kept clean. The purpose of the middle roller is to keep the uncoated side of the paper from coming in contact during coating operations.

Sometimes a band of strong muslin is stretched over the rollers and the paper run over this; but it is hardly necessary when a good quality of paper is being used.

The paper is cut in lengths of 12 or 15 feet and passed around the rollers, and the ends cemented together to make an endless roll.

The emulsion tray is so arranged that the pigmented gelatine may be maintained at a given temperature, and may be raised and lowered at will.

When all is ready the crank is turned with a steady, uniform motion, until the entire band of paper has been coated with the pigmented gelatine. At this juncture the paper is raised out of the emulsion tray and the band of coated paper is kept revolving until the gelatine has set, which will take but a few minutes.

The speed of the rollers, when coating the paper must be arranged in accordance with the consistency of the gelatine emulsion, and the thickness of film desired.

The slower the paper passes through the pigmented gelatine the thinner will be the film, and the faster, the heavier will it be.

After the gelatine has set, the band is cut through and hung up on a hanger arranged for the purpose and left to dry. The drying should take place in from 4 to 6 hours.

The time occupied in drying depends to a great extent upon the thickness of the pigment film and its composition.

Soap, sugar and glycerine retard the drying; also some of the pigments or coloring matter. If the paper is left exposed too long in a dry atmosphere, the film will become brittle and horny and quite difficult to manage; it should therefore, be taken down when quite pliable.

The proper time to take it down, is when apparently all the moisture has disappeared, and before it begins to cockle and curl up.

Cut it up into the desirable sizes and store it in tin pres-

sure boxes, where it will remain pliable, and in good working condition, indefinitely.

To preserve rolls or large sheets of tissue place a sheet of soft paper over the face of the film, and roll it face outward around a small roller. The paper will protect the film from injury while the tissue is being handled.

If the roll of carbon paper is placed within an air-tight tin receptacle, it will remain in good workable condition and may be cut up as desired for use.

Walter White conceived the idea of coating pigmented gelatine upon a non-actinic surface, such as red, green, yellow or black paper, which when sensitized, is squeegeed against an ebonite or ferrotype plates, where it is left to dry.

The only advantage of using tissue of this kind, is that it may be dried in any convenient place in daylight, and the film be protected from dust and injurious gases as well as light.

An English manufacturing concern purchased Mr. White's patent, and the paper, or daylight tissue as it is called, is now obtainable commercially.

CHAPTER VIII.

A BRIEF HISTORY OF THE CARBON PROCESS.

VAUQUELIN, in 1798, discovered chromium and chromic acid; and observed that chromic acid and silver, formed a carmine red salt, which when exposed to light, turned to a purple red color.

Mungo Ponton is supposed to have known of Vauquelin's discovery, and through it, was led to observe the sensitive nature of bichromate of potash when spread upon paper and exposed to light, when dry.

In 1814, Joseph Nicephore Niepce discovered the action of the solar rays upon certain hydro-carbons, which were rendered insoluble wherever they had been exposed to the influence of light.

In 1832, Dr. G. Suckow, of Jena, stated that bichromate of potash in contact with organic matter was reduced by the action of light, to a greenish brown color.

In 1839, Mungo Ponton, was the first to observe the action of light upon sized paper impregnated with bichromate of potash.

M. Becquerel discovered that through the action of chromic salts, organic substances, such as starch, gum, gelatine, etc., were rendered insoluble when exposed to the influence of light.

In 1855, M. Poitevin invented the first real carbon process. He found that when a thick solution of gelatine, incorporated with a coloring matter, had been made sensitive with bichromate of potash, and exposed to the action of light, it was rendered partly or wholly insoluble, according

to the penetrating power or actinism of the light to which it was exposed. His mode of development, however, was quite impracticable and consequently very difficult to accomplish.

The Abbé de Laborde, of France, J. C. Burnette, and M. Blair, of Perth, were experimenting on the same plan, and discovered that the surface of the pigmented film of a sensitive gelatine tissue, when in contact with a negative and exposed to light, became wholly insoluble; and that the insolubility formed upon the surface of the film, prevented the warm water from getting to the soluble portion of the gelatine on the back. This discovery clearly demonstrated that in order to obtain pictures having deep shadows and properly graded half-tones, the development could only be affected from the back or opposite side.

Shortly afterwards, M. Fargier invented and patented a process by which could be accomplished what was wanting in M. Poitevin's process. It consisted in coating a glass plate with a sensitive pigmented gelatine, which, when dry, was exposed to the action of light under a negative. He then coated the exposed tissue with a tough collodion which, when set, was plunged into warm water; the warm water made soluble the unaffected gelatine in contact with the glass, which left the picture floating in the water, held together by the collodion film. This was turned over and brought gelatine side-uppermost upon a piece of prepared paper. The resulting pictures were thought at the time, to be exceedingly beautiful.

The gradations and delicate half-tones obtained in this manner, surpassed all previous efforts in carbon printing. However, owing to the several difficult manipulations involved in this process, it never became practicably useful.

In 1864, J. W. Swan, of England, was awarded a patent on a pigmented tissue and the use thereof.

His mode of procedure at first was very similar to M. Fargier's, in so far that it consisted in coating a collodionized glass with a pigmented gelatine compound which, when dry was stripped from the glass, and thus was introduced the first carbon tissue.

The invention of Mr. Swan's tissue marked a very important epoch in the history of the carbon process, and was followed by several other improvements of equal importance.

The tissue was exposed, collodion side in contact with the negative, which allowed the application of warm water to the soluble gelatine at the back, and the developing manipulations were most conveniently and successfully done. Yet for all that this was quite a step in advance of the methods previously employed, it was apparent from the start that some means would have to be devised, by which to support the film during development. To this end Mr. Swan made a great many experiments, and finally invented a temporary support made of stout paper coated with an India rubber solution, and at the same time coating the collodion side of the tissue with the same, and then forcing the two surfaces into absolute contact by putting them through a press. The tissue supported in this manner by the India rubber paper, made the washing away of the soluble portions of the pigmented gelatine at the back and all the developing manipulations comparatively easy to perform. The resulting picture remained on the rubber film in relief, with all the fine detail and gradations possible to obtain from the negative employed.

For the benefit of the student I will give the patent specifications of Mr. Swan's Carbon Process.

CHAPTER IX.

PATENT SPECIFICATION OF SWAN'S CARBON PROCESS.

MY INVENTION relates to that manner or style of photographic printing known as carbon or pigment printing. In this style of printing, carbon or other coloring matter is fixed by the action of light passing through a negative, and impinging upon a surface composed of gelatine, or other like substance, colored with carbon or other coloring matter, and made sensitive to light by means of bichromate of potash, or bichromate of ammonia, or other chemical substance having like photographic property; those portions of the colored and sensitive gelatinous surface which are protected from the light by the opaque or semi-opaque portions of the negative, being afterwards washed away by means of water, while the parts made insoluble by light remain, and form a print. This kind of photographic printing, although possessing the advantage of permanency, and affording the means of insuring any required tone or color for the print, has not come into general use, because of the difficulties hitherto experienced in obtaining by it delicacy of detail, and complete gradation of light and shade.

"The difficulties referred to were more particularly experienced in attempts to employ paper coated with the colored gelatinous materials, and arose from the fact, that, in order to obtain half-tone, certain portions of the colored coating lying behind or at the back of the photographically-impressed portions required to be washed away, and the employment of paper in the way it has been employed hitherto, not only as a means of supporting the colored coating, but

also to form ultimately the basis or groundwork of the print, obstructed the removal of the inner or back portions of the colored coating, and prevented the obtaining of half-tone.

"Now, my invention consists in the formation of tissues adapted to the manner of printing referred to, and composed of, or prepared with, colored gelatinous matter, and so constructed, that while they allow, in the act of printing, free access of light to one surface of the colored gelatinous matter, they also allow free access of water, and the unobstructed removal of the non-affected portions of the colored matter, from the opposite surface, or back, in the act of developing; and I obtain this result either by the disuse of paper altogether, or by the use of it merely as a backing or temporary support of the colored gelatinous matter; the paper, so used, becoming entirely detached from the colored gelatinous matter in the act of developing, and forming no part of the print ultimately.

"My invention consists, furthermore, in the special mode of using the said tissues, whereby superior half-tone and definition in the print are obtained as aforesaid, and also in a mode of transferring the print, after developing, from a temporary to a permanent support, so as to obtain a correction in the position of the print in respect of right and left. In producing the photographic tissues referred to, I form a solution of gelatine, and for the purpose of imparting pliancy to the resultant tissue, I have found it advisable to add to the gelatine solution, sugar or other saccharine matter, or glycerine. To the said gelatinous solution I add carbonaceous or other coloring matter, either in a fine state of division, such as is used in water-color painting, or in the state of a solution or dye, or partly in a fine state of division, and partly in solution.

"With this colored gelatinous solution I form sheets or

films as hereafter described; and I render such sheets or films sensitive to light, either at the time of their formation, by introducing into the gelatinous compound bichromate of ammonia, or other agent of like photographic properties, or by applying to such non-sensitive sheets or films, after their formation, a solution of the bichromate, or other substances of like photographic property. This latter method I adopt when the sheet or film is not required for use immediately after its formation. I will, in my future references to the bichromate of ammonia or the bichromate of potash, or to other chemicals possessing analogous photographic properties, denominate them *'the sensitizer;'* and in referring to the colored gelatinous solution, I will denominate this mixture *'the tissue-compound.'* When the tissue to be produced is required for immediate use, I add the sensitizer to the tissue compound; but, where the tissue is required to be preserved for some time before using, I prefer to omit the sensitizer from the tissue-compound, with a view to the tissue being made sensitive to light subsequently, by the application of a solution of the sensitizer.

"With respect to the composition of the tissue-compound, it will be understood by chemists, that it may be varied without materially affecting the result, by the addition or substitution of other organic matters, similarly acted upon by light, when combined with a salt of chromium, such as I have referred to. Such other organic matters are gum arabic, albumen, dextrine; and one or more of these may be employed occasionally to modify the character of the tissue-compound, but I generally prefer to make it as follows: I dissolve, by the aid of heat, two parts of gelatine, in eight parts of water, and to this solution I add one part of sugar, and as much coloring matter in a finely divided state, or in a state of solution, or both, as may be required for the produc-

tion of a photographic print with a proper gradation of light and shade. The quantity required for this purpose must be regulated by the nature of the coloring matter employed, and also by the character of the negative to be used in the printing operation. Where it is desired that the coloring matter of the print should consist entirely or chiefly of carbon, I prefer to use lampblack finely ground and prepared as for water-color painting, or I use India-ink; and where it is desired to modify the black, I add other coloring matter to produce the color desired. For instance, I obtain a purple black by adding to the carbon, indigo and crimson-lake, or I add to the carbon an aniline dye of a suitable color; where the coloring matter is not a solution or dye, but solid matter in a fine state of division, such as India-ink or lampblack, I diffuse such coloring matter through water, or other inert liquid capable of holding it in suspension; and after allowing the coarser particles to subside, I add, of that portion which is held in suspension, as much as is required, to the gelatine solution. In preparing tissue to be used in printing from negatives technically known as 'weak,' I increase the proportion of coloring matter relatively to that of the tissue-compound; and I diminish it, for tissue or paper to be used in printing from negatives of an opposite character.

"Having prepared the tissue-compound as before described, I proceed to use it as follows: For preparing sensitive tissue, I add to the tissue-compound more or less of the sensitizer, varying the quantity added, according to the nature of the sensitizer, and to the degree of sensitiveness to be conferred on the tissue to be produced from it. For ordinary purposes, and where the tissue-compound is made according to the formula before given, I add about one part of a saturated solution of bichromate of ammonia to ten parts of the tissue-compound; and I make this addition immediately

previous to the preparation of the tissue, and I maintain the tissue-compound in the fluid state, by means of heat, during the preparation of the tissue, avoiding the use of an unnecessary degree of heat; I also filter it through fine muslin or flannel, or other suitable filtering medium, previous to use; and I perform all the operations with the tissue-compound, subsequent to the introduction of the sensitizer, in a place suitably illuminated with yellow or non-actinic light. In forming tissue upon a surface of glass, I first prepare the glass, so as to facilitate the separation of the tissue from it. For this purpose, I apply ox-gall to the surface of the glass (by means of a brush, or by immersion), and allow it to dry. The glass is then ready for coating with the tissue-compound, or I apply to the glass a coating of collodion, previous to the application of the coating of tissue-compound. In this case, the preparation with ox-gall is unnecessary. When collodion is used, the collodion may consist of about ten grains of pyroxyline in one ounce of mixture of equal parts of sulphuric ether and alcohol. I apply the collodion by pouring it on the surface to be coated, and draining off the excess and I allow the coating of collodion to become dry before applying the coating of tissue-compound. I generally use a plane surface on which to form the tissue, but surfaces of a cylindrical or other form may sometimes be used advantageously. In preparing sheets of sensitive tissue on a plane surface of glass, I prefer to use the kind of glass known as plate, or patent plate. Before applying the sensitive tissue-compound, I set the plate to be coated, so that its upper surface lies in a horizontal position, and I heat the plate to about the same temperature as the tissue-compound, that is, generally, to about 100 degrees, Fahrenheit. The quantity of the tissue-compound that I apply to the glass varies with circumstances, but is generally about two ounces to each

square foot of surface coated. After pouring the requisite quantity of the tissue-compound upon the surface of the plate, I spread or lead the fluid by means of a glass rod or soft brush, over the entire surface, taking care to avoid the formation of air-bubbles; and I keep the surface in the horizontal position, until the solidification of the tissue-compound. In coating other than plane surfaces, I vary, in a suitable manner, the mode of applying the tissue-compound to such surfaces. In coating a cylindrical surface, I rotate the cylinder in a trough containing the tissue-compound, and after having produced a uniform coating, I remove the trough, and keep up a slow and regular rotation of the cylinder until the coating has solidified. After coating the surface of glass or other substance as described, I place it in a suitable position for rapid drying, and I accelerate this process by artificial means, such as causing a current of dry air to pass over the surface coated, or I use heat, in addition to the current of air, or I place it in a chamber containing quicklime, chloride of calcium, or other substance of analogous desiccating property. When the tissue is dry, I separate it from the surface on which it was formed, by making an incision through the coating to the glass, around the margin of the sheet; or I cut through the cylindrical coating near the ends of the cylinder, and also cut the coating across, parallel with the axis of the cylinder, when, by lifting one corner the whole will easily separate in a sheet. When the tissue-compound is applied over a coating of collodion, the film, produced by the collodion, and that produced by the tissue-compound, cohere, and the two films form one sheet. Sometimes, before the separation of the coating from the glass, I attach to the coating a sheet of paper, for the purpose of strengthening the tissue, and making it more easy to manipulate. I generally apply the paper, in a wet state, to the dry

gelatinous surface; and having attached the paper thereto in this manner, I allow it to dry; and I then detach the film and adherent paper from the glass, by cutting around the margin of the sheet, and lifting it off as before described. Where extreme smoothness of surface, such as is produced by moulding the tissue on glass, as described, is not of importance; and where greater facility of operation is desired, I apply a thick coating of the tissue-compound to the surface of a sheet of paper. In this case, the paper is merely used as a means of forming, and supporting temporarily, the film produced from the tissue-compound; and such paper separates from the gelatinous coating in a subsequent stage of my process. In coating a surface of paper with the sensitive tissue-compound, I apply the sheet, sometimes of considerable length, to the surface of the tissue-compound contained in a trough, and kept fluid by means of heat, and I draw or raise the sheet or length of paper off the surface with a regular motion; and I sometimes apply more than one coating to the same sheet in this manner. After such coating, I place the coated paper where it will quickly dry, and seclude it from injurious light.

"The sensitive tissue, prepared as before described, is, when dry, ready to receive the photographic impression, by exposure under a negative in the usual manner, or by exposure in a camera obscura, to light transmitted through a negative in the manner usual in printing by means of a camera. I prefer to use the sensitive tissue within two days of the time of its preparation. Where the tissue is not required for immediate use, I omit the sensitizer from the tissue-compound, as before mentioned; and with this non-sensitive tissue-compound I coat paper, glass, or other surface, as described in the preparation of the sensitive tissue or paper. In preparing sheets of non-sensitive tissue by means of glass,

as described, I use no preliminary coating of collodion. I dry the non-sensitive tissue in the same manner as the sensitive, except that in the case of the non-sensitive tissue, seclusion from daylight is not necessary.

"The non-sensitive tissue is made sensitive, when required for use, by floating the gelatinous surface upon a solution of the sensitizer, and the sensitizer that I prefer to use for this purpose is an aqueous solution of the bichromate of potash containing about two and a half per cent of this salt. I apply the sensitizer (by floating or otherwise), to the gelatinous surface of the tissue; and after this, I place it in a suitable position for drying, and exclude it from injurious light.

"In applying to photographic printing the various modifications of the sensitive tissue, prepared as before described, I place the sensitive tissue on a negative in an ordinary photographic printing-frame, and expose to light in the manner usual in photographic printing; or I place it in a camera obscura in the manner usual in printing by means of a camera obscura. When the tissue employed is coated with a film of collodion on one side, I place the collodionized side in contact with the negative; or where it is used in the camera, I place the collodionized side towards the light passing through the camera lens. Where the tissue is not coated with collodion, and where paper forms one of the surfaces of the tissue, the other surface being formed of a coating or film of the tissue-compound, I place this last-named surface in contact with the negative; or, when using it in the camera, I present this surface towards the light transmitted by the lens. After exposure for the requisite time, I take the tissue from the printing-frame or camera, and mount it in the manner hereinafter described, that is to say, I cement the tissue, with its exposed surface, or, in other words, with that sur-

face which has received the photographic impression, downward, upon some surface (usually of paper) to serve temporarily as a support during the subsequent operation of developing, and with a view to the transfer of the print, after development, to another surface; or I cement it (also with the exposed or photographically impressed surface downward), upon the surface to which it is to remain permanently attached. The surface, on which it is so mounted, may be paper, card, glass, porcelain, enamel, etc. Where the tissue has not been coated with collodion previous to exposure to light, I prefer to coat it with collodion on the exposed or photographically impressed side, before mounting it for development, but this is not absolutely necessary; and I sometimes omit the coating with collodion, more particularly where the print is intended to be colored subsequently. Or where I employ collodion, with a view to connect the minute and isolated points of the print firmly together during development, I sometimes ultimately remove the film it forms, by means of a mixture of ether and alcohol, after the picture has been finally mounted, and the support of the film of collodion is no longer required. In mounting the exposed tissue or paper previous to development, in the temporary manner, with a view to subsequent transfer to another surface, I employ, in the mounting a cement that is insoluble in the water used in the developing operation, but that can be dissolved afterwards, by the application of a suitable solvent; or one that possesses so little tenacity, that the paper or other support, attached temporarily to the tissue or paper by its means, may be subsequently detached without the use of a solvent.

"The cements that may be used for temporary mounting are very various, but I generally prefer to use a solution of India-rubber in benzole or other solvent, containing about

six grains of India-rubber in each ounce of solvent, and I sometimes add to the India-rubber solution a small proportion of dammar-gum, or gutta-percha. In using this cement, I float the photographically impressed surface of the tissue upon it, and I treat, in a similar manner, the paper or other surface intended to be used as the temporary mount or support during development; and, after allowing the benzole or other solvent to evaporate, and while the surfaces coated with the cement are still tacky I press them strongly together in such a manner as to cause them to cohere.

"When the photographically impressed, but still undeveloped tissue is to be cemented to a surface, that not only serves to support the picture during its development, but also constitutes permanently the basis of the picture, I prefer to use albumen or starch paste as the cementing medium; and where I employ albumen I coagulate or render it insoluble in water (by means of heat, by alcohol, or other means), after performing the cementing operation, and previous to developing. In the permanent, as in the temporary mode of mounting, I cement the tissue, *with its photographically impressed surface downwards,* upon the surface to which it is to be permanently attached. Atfer mounting the tissue, as before described, and allowing the cement used time to dry, where it is of such a nature as to require it, I then submit the mounted tissue to the action of water, sufficiently heated to cause the solution and removal of those portions of the colored gelatinous matter of the tissue which have not been rendered insoluble by the action of light during exposure in the printing-frame or camera. Where paper has been used as a part of the original tissue, this paper soon becomes detached by the action of the warm water, which then has free access to the under stratum or back of the colored gelatinous coating, and the soluble portions of it are therefore

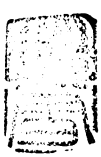
readily removed by the action of the water; and by this means the impression is developed that was produced by the action of light during exposure of the tissue in the printing-frame or camera, and the picture remains attached to the mount, cemented to the photographically impressed surface previous to development. I allow the water to act upon the prints during several hours, so as to dissolve out the decomposed bichromate as far as possible. I then remove them from the water, and allow them to dry, and those not intended for transfer, but that have been permanently attached to paper, previous to development, I finish by pressing and trimming in the usual manner. Those which have been temporarily mounted, I transfer to paper, card, or other surface. In transferring to paper or card, I coat the surface of the print with gelatine, gum arabic, or other cement of similar character, and allow it to dry. I then trim the print to the proper shape and size, and place its surface in contact with the piece of paper or card to which the transfer is to be effected, such piece of paper or card having been previously moistened with water, and I press the print and mount strongly together; and, after the paper or card has become perfectly dry, I remove the paper or other supporting material, temporarily attached, previous to development, either by simply tearing it off, where the cement used in the temporary mounting is of a nature to allow of this without injury to the print, or I apply to the temporary mount, benzole or turpentine, or other solvent of the cement employed, or I immerse the print in such solvent, and then detach the temporary mount, and so expose the reverse surface of the print; and, after removing from the surface of the print, by means of a suitable solvent, any remains of cement used in the temporary mounting, I finish the print by pressing in the usual manner. If, however, the print be collodionized, and be re-

quired to be tinted with water-color, I prefer to remove the collodion film from the surface of the print, and this I do by the application of ether and alcohol.

"Having now set forth the nature of my invention of 'Improvements in Photography,' and explained the manner of carrying the same into effect, I wish it to be understood, that under the above in part recited letters-patent, I claim: First, the preparation and use of colored gelatinous tissues in the manner and for the purpose above described.

"Secondly, the mounting of undeveloped prints, obtained by the use of colored gelatinous tissues, in the manner and for the purpose above described.

"Thirdly, the re-transfer of developed prints produced as above described, from a temporary to a permanent support."



CHAPTER X.

THE next important improvement Mr. Swan made in the production of carbon tissue was a lasting one. For, with but few alterations, it remains the same to this day. He discarded the collodion film, which necessitated the troublesome manipulations of coating the glass, and simply coated a sheet of tough paper with the pigmented gelatine compound. After this tissue had been exposed to light under a negative, it was coated with a rubber solution and forced into contact with a rubber-coated paper the same as the collodion film previously described.

The two adhering sheets were then put into warm water, which softened the gelatine in contact with the paper upon which it was coated, allowing it to be stripped from the pigment film, which remained resting on the rubber-coated paper. The soluble side of the film was thus exposed to the action of the warm water and the picture was developed, resting upon the rubber paper in beautiful relief. Printed from ordinary negatives, these pictures were reversed like the Daguerreoytpe, the right side being on the left or *vis-a-vis*. This, practically, was the first single transfer process.

Although these pictures were very beautiful, they were, however, in many instances objectionable on account of their reversed positions.

To overcome this difficulty, Mr. Swan devised another means by which the pictures were again reversed and the evil practically surmounted.

His method of reversing the image was to transfer it to a tough paper support, which had previously been coated

with a partly insoluble gelatine, and put under pressure until dry.

The India rubber coated paper was then moistened on the back with benzine, which caused the film to dissolve and the paper could be stripped, leaving the picture firmly adhering to the final support.

This was the introduction of the double transfer process, by which many very excellent pictures have been made, and which were surpassed only very recently by the superior excellence of our modern methods.

However perfect the process seemed to be at the time, there yet remained one serious imperfection—the absence of a proper gradation, ranging from light to dark. Most of the pictures produced were one abrupt step from light to shade, and any approach to delicacy marked half-tones were exceedingly rare.

This caused the notion to prevail that the finest mechanical subdivision of a pigment could not equal in delicacy and fineness, the deposit obtained by the chemical reduction of the salts of silver or platinum.

It was afterwards plainly proven, however, that this was not the cause of the difficulty; but that it was the fault of the crude and impractical developing methods that caused the imperfection, instead of the pigments used.

In 1867, Mr. J. R. Johnson introduced a method of developing carbon pictures that was a decided step in advance of all previous inventions. It lessened the expense as well as the number of manipulations to an extent that it has remained virtually the same for thirty years.

His experiments were based upon the principle, that if a moist film be pressed into perfect contact with a flat, smooth surface, which is impervious to air, it will firmly adhere thereto without the aid of an adhesive.

He found that this principle could be successfully employed in the development of carbon pictures. The tissue was placed in cold water until it became limp, and was then placed upon a support and firmly squeezed into contact with its surface and developed. In this manner he transferred his tissue to either temporary or permanent supports without the aid of an adhesive preparation.

The tissue, on its impervious support, was allowed to rest for a short time and was then placed in warm water, which dissolved the soluble gelatine at the back and allowed the paper to be removed, which revealed a dark mass of partially soluble pigmented gelatine. The soluble parts were then removed by the gentle application of warm water and the carbon picture in all its beauty was left resting upon the support.

The greater part of all the carbon pictures produced in this country at the present time are developed in this manner upon matt surface, celluloid, or opal glass.

Carbon pictures transferred to these supports are very beautiful and are becoming quite popular among the better classes.

The only serious objection to Mr. Johnson's improvement was that, like in Mr. Swan's process, the image was reversed and to bring it into its proper position it had to be corrected by again transferring it to another support.

In 1874, Mr. J. R. Sawyer invented a flexible temporary paper support to use in making pictures by the double transfer process. It is made by first coating a hard, tough paper with an insoluble gelatine, and then with an alkaline solution of lac. When thoroughly dry, it is rolled and polished.

To use, it is necessary to apply a waxing solution which allows the free and easy separation of the carbon picture from the temporary to the final support.

The yielding nature of this paper support has many advantages over other temporary supports, especially where the pictures are to be transferred to an uneven or curved surface.

Late in the seventies, a Frenchman, M. Lambert, created quite a stir in Europe and later in this country, by exhibiting pictures with a brilliant, glass-like surface. His collection was probably the finest lot of carbon pictures ever exhibited in this, or any other country. I was a mere apprentice at the time, but after seeing this beautiful collection of pictures, I was so infatuated with this charming process that I have devoted a great deal of time and attention to it ever since.

M. Lambert's improvement, for which he obtained a patent, consisted in polishing a glass plate with a waxing solution and then coating it with plain collodion. Upon these collodionized plates he mounted the exposed carbon tissue, which, after development, was again transferred to a permanent support and then stripped from the glass and mounted on cards.

The surface of these pictures had all the brilliancy and luster of a polished plate glass and were exceedingly beautiful. Great interest was manifested in the process at that time, and M. Lambert's method was eagerly taken up by many of the most prominent men of the profession; but, unfortunately, in spite of the great beauty of these pictures this method proved itself difficult and unprofitable, and the process gradually sank into neglect and silent forgetfulness, and for fifteen years was very little heard of, especially in America.

The fading products of the silver process again awakened a new interest in this seriously neglected process, and it has been steadily growing until it is now looked up to as the standard of perfection in photographic printing processes.